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THE QUARTERLY BULLETIN

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PRELIMINARY REPORT UPON AN IMPROVED METHOD OF CONTROLLING THE BOLL WEEVIL[1]

By Geo. D. Smith

As there is available, thru state and federal publications, a large amount of information concerning the boll weevil, its invasion of the cotton-growing states, its habits, life history, etc., no attempt is made in the present paper to discuss these matters except in so far as they have more or less bearing upon the experimental work and results herein described.

PAST EFFORTS TO CONTROL THE BOLL WEEVIL

Efforts to control the boll weevil very naturally commenced with its appearance in alarming numbers in the southern part of Texas in 1894 and have continued ever since. In fact, the history of the boll weevil in the South has been one of unending effort on the part of both cotton growers and scientists to find some way of either satisfactorily outwitting the insect or reducing its numbers to the point where profitable crops of cotton would be assured.

These investigations have developed certain farm practices which are of value in that they assist in bringing about a partial control of the pest but, by themselves, are not effective enough to insure good crops of cotton under normal weevil conditions. The most important recommendations which have been made in this regard are substantially as follows: Early fall destruction of the cotton plants by burning, plowing under or grazing; destruction of volunteer cotton; destruction of hibernating weevils by burning off stubble fields, ditch banks, margins of wooded areas, etc.; selecting fields for cotton with a view to getting as far as possible from the weevil's hibernating quarters; thoro preparation of the seedbed; early planting, use of early-maturing

[1]Published also as Bulletin 165 of the University of Florida Agricultural Experiment Station.

varieties, use of fertilizers and thoro cultivation of the growing crop.

EFFORTS AT CONTROL WITH POISONS

The idea of using a poison against the weevils has naturally proven a very attractive one, to both planters and investigators. As poison has been utilized in our experiments during 1922 and as its intelligent use forms a necessary part of the improved method of control which is described on subsequent pages, a brief review of the efforts made to utilize poisons against the boll weevil during the last 25 years may not be out of place at this point.

Among the first things tried as remedies for the boll weevil, upon the appearance of this pest in southern Texas, were arsenical poisons. The first careful investigation of the weevil and its habits was made in 1894, in southern Texas, by C. H. Tyler Townsend, an entomologist of the Division of Entomology, United States Department of Agriculture. After a study of the weevil for two months, Professor Townsend recognized the possibility of killing some of the weevils with arsenical poisons and in a report[2] upon his investigations, he says:

> "Paris green or London purple, applied in solution of one pound of poison to 150 gallons of water when the bolls begin to form, may kill a certain per cent of the weevils, if good judgment is used in its application."

That the use of poison against this insect was considered possible, even promising, at the beginning of the investigations is shown by the following statement by L. O. Howard in Circular 6, second series. Division of Entomology, issued April 2, 1895:

> "Living as the larva does, in the interior of the bud or boll, it cannot be reached by ordinary insecticides, although an application of Paris green or London purple, as for the cotton worm, made when the bolls begin to form, may kill a certain percentage of the adult weevils, since these feed, to some extent, upon the outside of the bolls."

The Division of Entomology made a thoro test of the arsenical insecticides then in common use, such as paris green and london purple, and established the fact that some of the over-wintered weevils could be killed by paris green while the plants were still small. Dr. Howard, writing in February, 1897[3], said, in reference to the volunteer cotton which grows in southern Texas:

[2]Insect Life, Vol. VII, p. 305, March, 1895.
[3]Circ. 18, sec. ser., Div. of Entomology, p. 6.

> "It should be understood at the outset that experience has shown that none of the general applications of insecticides are of the slightest value against this species as a means of protecting infested fields. The weevil in its work in growing cotton is thoroughly protected against poisons, breeding as it does within the blossoms and squares. As demonstrated by the experience of the spring of 1896, poisons may be used as a means of destroying over-wintered beetles on volunteer cotton. The beetles which have survived the winter collect in the early spring on the first sprouts which appear on old cotton and eat the partially expanded leaves and the tender leaf stems, and at this stage can be poisoned by the application of an arsenical to this new growth."

Dr. Howard did not recommend the use of the arsenical spray upon the main field crop, but only on the volunteer and sprout cotton for the destruction of the weevils which had lived thru the winter.

After continued experiments in trying to poison the boll weevil, the Division of Entomology recommended to the planters in July, 1898[4], that use be made of a liquid spray of white arsenic, molasses and water on the young plants of the main field crop as well as on the volunteer cotton. This recommendation was apparently not tested in actual field experiments in which the yields from poisoned and non-poisoned cotton were determined, but was based upon the results of experiments made by confining weevils in cages containing plants which had been treated with the poisonous mixture. At the same time Dr. Howard laid special stress upon the importance of the cultural methods to reduce weevil ravages, the use of poison being suggested as an auxiliary.

In 1899 F. W. Mally, state entomologist of Texas, undertook extensive investigations of the boll weevil, which continued until 1902. Mally decided that the cultural methods were of first importance in producing cotton in the weevil districts and at the same time he concluded from his experiments that much good could be accomplished by spraying the cotton early in the season with a mixture of white arsenic, arsenate of lead, molasses and water. At the same time, actual experiments with the mixture, made after cotton plants were fruiting, resulted in a reduction of from 5 to 25 percent in the number of weevils[5]. The spraying of cotton with the mixtures recommended by Mally became quite general in Texas during 1902 and 1903. Many expensive, complicated sprayers were purchased for the purpose

[4]Howard, L. O., Circ. 33, sec. ser., Div. of Entomology.

[5]"Report on the Boll Weevil," by F. W. Mally, Austin, Texas, August, 1902, p. 60.

and much money was expended for the necessary poisons and molasses. Many planters reported profitable results from such spraying but gradually it was discontinued.

In 1904 B. W. Marston of Louisiana, who in that year visited various parts of Texas, made experiments with paris green and advocated its use as a boll weevil remedy. However, the use of paris green was soon abandoned. The Bureau of Entomology, having conducted further tests during 1904, came to the conclusion that profitable use of arsenical poisons against the weevil could not be hoped for. Statements to that effect appear in several of the Bureau's publications[6].

Wilmon Newell, of the Louisiana State Crop Pest Commission, began studying the use of poisons in controlling the boll weevil in 1903 and, as the experiments both in cages and field tests indicated that paris green could not be used successfully, he turned his attention to the development of a new poison.

The paris green experiments were largely responsible for his idea of testing other chemicals, as the experimental data had shown that weevils could be killed with poison. The fact that the soluble arsenic in paris green injured the cotton plants and reduced the yield, even when used in very small quantities, led Mr. Newell to make an effort to eliminate the soluble arsenic by soaking the paris green in water before using.

The results in excluding the water-soluble arsenic were encouraging and it was then thought that a powdered form of arsenate of lead, something unknown at that time, might solve the difficulty. The finely powdered form of lead arsenate was successfully made for the first time in Mr. Newell's laboratory during 1904. The results of preliminary tests with this new form of arsenate were published in July, 1908, in Circular 23 of the Louisiana State Crop Pest Commission.

In 1909 the writer conducted extensive field tests for controlling the weevil with powdered arsenate of lead under the direction of Mr. Newell. The results of these field tests were encouraging and were published as Bulletin 33 of the State Crop Pest Commission of Louisiana in December, 1909. They indicated very positively that a certain degree of control could be secured by poisoning the weevil in early summer with lead arsenate but that applications made in midsummer, during the season of heavy rains, would not hold the weevil in check. The

[6]Bulletin 45, Bureau of Entomology, pp. 42, 43, 112 and 113; Farmers' Bulletin 211, pp. 21-22; Farmers' Bulletin 216, p. 24, etc.

experiments showed a very definite profit and indicated the possibility of making still further progress in the use of poisons against the weevil.

Certain very well-defined principles were established as being necessary in the use of poisons for this insect. In the first place, it was shown that, prior to the appearance of the first squares the weevils could be poisoned in large numbers and that one or two applications made just after the first squares appeared were more profitable than later applications.

It was also demonstrated that when squares are on the cotton plants it is difficult to force the poison down inside the involucres, or shucks, surrounding the squares, where the weevil commonly feeds, and many weevils are not poisoned. Various types of dust guns were devised for forcing the poison into the squares and buds, but it was soon found that the air blast machine was the only one that was even partially successful.

In 1910 the writer was placed in charge of the boll weevil poisoning tests for the Bureau of Entomology, United States Department of Agriculture, at Tallulah, Louisiana. Tests were made with powdered arsenate of lead on a very large scale from 1910 to 1914. The results corresponded quite closely to those secured under Mr. Newell's direction in 1908-09 and the conclusion was reached that, altho powdered arsenate of lead, used during midsummer, would kill a great many weevils and give a certain amount of control, it was impractical for the average cotton grower to attempt its use.

B. R. Coad, who succeeded the writer in 1915, was placed in charge of the experimental work at the Tallulah laboratory. He turned his attention to the development of an improved form of powdered calcium arsenate, and the results are now well known.

The so-called calcium arsenate method of weevil control has not been found adapted to Florida conditions, for the principal reason that several applications and relatively large amounts of poison to the acre are required and the expense absorbs practically the difference between the cost of growing the crop and its market value.

In fact, the United States Department of Agriculture does not recommend this method for controlling the weevil on land which is incapable of producing at least half a bale of cotton to the acre in the absence of the boll weevil[7]. The Census of 1910

[7]Bulletin 875, U. S. D. A., p. 28.

showed the normal production of cotton in Florida to be a quarter of a bale to the acre.

It is, therefore, self-evident that the Florida farmer must have a method of boll weevil control which can be utilized without the necessity of purchasing expensive machinery and applying large quantities of poison, involving the expenditure of several dollars to the acre. We believe the method which has been tested during the season of 1922, and which is described herein, overcomes these difficulties, so far as short staple cotton is concerned.

EXPERIMENTS ALONG A NEW LINE

It has long been known that the boll weevil can be quite effectively poisoned during the period preceding the appearance of the first squares. However, the last of the over-wintering weevils do not emerge from their hibernating quarters until several days after the cotton plants normally begin square formation. A suitable application of lead or calcium arsenate, made just before the squares appear, kills practically all weevils in the field. But the weevils emerging later on deposit their eggs in the early squares, thus starting the season's infestation. After squares develop, the adult weevil is difficult to poison and the poison, of course, has no effect on the eggs and larvae, which are within the squares.

After several years of investigation it occurred to us that the first weevil generation of the season might be largely disposed of by removing or "stripping" from the cotton plants the first squares of the season, and with them the eggs deposited by the over-wintered weevils.

During 1919-21, while stationed at Madison, Florida, and engaged in investigations for the Bureau of Entomology, United States Department of Agriculture, the writer made experiments in stripping squares from the cotton plants early in the season and, while this disposed of the first infested squares, it was observed that there always remained a considerable number of weevils.

These experiments were encouraging in that the extra amount of cotton produced on the stripped plots indicated that one stripping, altho it did not clear the field of weevils, was slightly beneficial and that two strippings, about ten days apart, would insure a marked increase in the quantity of cotton produced. On the other hand, two strippings might delay the fruiting of the

plants to a dangerous degree. However, the condition in which the cotton plant is left after removal of the squares is the very condition under which poison can be applied with most telling effect. Deprived of squares in which to hide and on which to feed, the weevil must necessarily turn to the terminal or growing bud of the plant for food. It is very easy to literally fill this terminal bud with a suitable poison by means of a good dust gun.

At this time, also, the over-wintered weevils have only a few more days to live and their instinct to survive urges them to feed liberally. The application of poison to the terminal buds at this stage has been followed, in all our experiments, by the destruction of practically every weevil that escaped capture in the stripping operation.

If the stripping is done about June 5 to 8, the number of weevils still remaining in winter quarters and which can still come to the cotton fields is of practically no consequence. These few stragglers cannot increase sufficiently to seriously affect the number of bolls set on the plants in the two months following.

Because such treatment of a cotton field may appear to the reader somewhat radical and because an understanding of the principles involved is quite necessary to a clear interpretation of the experiments described on subsequent pages, we are giving, first, a description of the methods used and the factors involved and, second, a detailed account of the experiments in which these principles have been applied.

THE IMPROVED METHOD OF CONTROL

The method of control which the writer has evolved is simple. In substance, it consists in clearing the cotton field, early in June, of all the adult weevils and, at the same time, of destroying their eggs and larvae; thus leaving the cotton plants free to develop squares and bolls without weevil interference for the succeeding seven or eight weeks.

Having disposed of the over-wintered weevils and their progeny, no additional weevils of any consequence will come to the field before the annual migration, which usually takes place about August 1. Upland (short staple) cotton bolls, which are more than half grown when the summer migration occurs, succeed in maturing and opening, because the first migratory weevils arriving in the fields late in July turn to the squares and do not attack the green bolls to any great extent.

In this respect the treated field, on arrival of the first migratory weevils, is in a condition comparable to that of any ordinary cotton field earlier in the season. That is, while the weevils are destroying the squares the bolls largely escape their attack.

In considering these facts it should be remembered that before the boll weevil appeared in Florida the cotton crop was normally "made" by the middle of August. On the Florida sandy soils the cotton plant shows a very determinate habit of growth; that is, it reaches practical maturity in the latter part of summer and does not normally make an appreciable amount of cotton after that time. Cleaning the cotton fields of weevils early in June, therefore, affords the cotton plant almost as long a period in which to set fruit as it enjoyed in a normal season prior to the advent of the weevil.

This fact undoubtedly explains why, in the majority of our experiments, yields have been secured practically as great as those upon the same farms before the boll weevil came.

RELATION OF HIBERNATION TO WEEVIL CONTROL

Data obtained in the hibernation experiments, which have been conducted for a number of years by both federal and state investigators in various parts of the South, give us a very accurate knowledge of the rate at which the weevils emerge from hibernation. These experiments, involving observations on many hundreds of thousands of weevils, show that fully 99 percent of them are out of their winter quarters and in the cotton fields by June 5. This is shown by reference to Table 1, taken from Bulletin 926, United States Department of Agriculture.

TABLE 1.—PERCENTAGE OF TOTAL EMERGENCE OF BOLL WEEVILS AT DIFFERENT DATES AND AT DIFFERENT PLACES

Date	Keatchie La., 1906	Tallulah, La.		Mensura, La		Dallas, Tex.		Calvert, Tex., 1907	Victoria, Tex., 1907	Madison, Fla., 1919
		1910	1911	1910	1909	1907	1908			
Feb. 21	0.00	0.31	36.95	1.64	7.20	0.00	0.00	0.00	0.00	3.6
Feb. 28	.00	.31	36.95	3.28	10.61	.00	.00	.00	12.01	5.03
Mar. 7	.00	6.62	39.92	10.56	19.22	24.48	7.27	22.80	27.92	21.9
Mar. 14	.00	10.09	63.83	15.69	19.73	36.36	23.63	31.90	48.23	30.2
Mar. 21	.00	13.56	70.35	21.19	23.24	57.14	45.45	44.30	66.24	34.2
Mar. 28	3.93	23.34	72.52	38.05	30.96	71.72	55.45	57.20	79.35	36.4
Apr. 4	6.87	35.95	74.69	46.53	38.16	75.70	63.63	64.20	84.16	41.4
Apr. 11	24.54	41.95	81.21	49.42	43.87	81.28	68.18	70.40	89.58	52.3
Apr. 18	32.11	46.05	87.73	52.41	47.78	84.46	74.54	77.40	93.80	57.7
Apr. 25	40.67	48.89	96.42	53.86	56.39	85.74	87.27	79.51	95.02	58.4
May 2	52.73	61.83	96.42	60.41	61.30	88.62	90.91	82.62	95.88	61.2
May 9	60.44	70.66	98.59	72.35	67.51	92.30	91.82	88.73	97.50	85.4
May 16	72.22	75.39	98.59	75.64	75.12	95.75	94.55	91.94	98.36	90.4
May 23	86.41	88.64	98.59	84.77	82.43	98.76	98.18	94.95	98.92	92.5
May 30	91.60	93.69	98.59	92.77	89.73	99.34	98.18	97.56	99.18	94.7
June 6	97.36	99.05	100.00	98.43	96.83	99.78	99.09	99.17	99.90	98.5
June 13	99.19	99.68	100.00	99.89	97.83	99.88	99.09	99.68	99.97	99.1
June 20	99.61	99.68	100.00	100.00	98.74	100.00	100.00	99.99	100.00	99.6
June 27	99.89	100.00	100.00	100.00	99.94	100.00	100.00	100.00	100.00	99.9
July 4	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.9
July 7	....	....	....	....	....	....	....	....	....	100.00

The data presented in Table 1 indicate quite clearly that June 5 is about the earliest date at which the control measures can be successfully applied. That is, on June 5 it is possible, by taking off all squares, to destroy all weevil eggs and larvae. At the same time, as nearly all weevils are feeding inside of the involucres (shucks) of the squares, it is possible to destroy a large percent of the adult weevils with the same operation.

When all squares have been removed, the weevils that were not captured by the stripping operation are forced to feed in the tender buds of the cotton plants, in the same manner as before the squares developed, and then a single dust application of any suitable arsenical will destroy practically all of them.

RELATION OF DATE OF PLANTING TO CONTROL

The date of planting is very important where the improved method of control is to be used. In Florida the weather is usually warm enough to permit planting about March 10, and some farmers plant their cotton at this extremely early date. It has been found during the course of these investigations that non-fertilized cotton planted about the last week in March will, under normal conditions, be in the right fruiting stage for treatment about June 5. If much fertilizer is used it is better to plant a week later. Should the season be late, the treatment can be delayed a few days or until enough squares have appeared on the plants to act as traps for the adult weevils.

On the other hand, planting too early, especially if the season is an early one and the cotton grows rapidly, involves a great deal more labor in picking off the squares at the time of treatment. It must be remembered that the rate at which the weevils emerge from hibernation is not accelerated by an early season to the same degree that the growth of the cotton plant is and, regardless of whether the season is early or late, the treatment for the weevil should not be given earlier than about June 5. Extremely early planting also means early hatching of the first generation of weevils. That is, extremely early cotton often produces enough squares to supply a generation of adults during the last week in May, before all over-wintered weevils are out of hibernation.

Therefore, it is advisable to plant the cotton only moderately early; say the last week of March, and thus have the plants ready to treat at the proper time.

RELATION OF LATE PLANTING TO CONTROL

Some of our readers might suggest that it would be better to wait until late in April before planting, so that there would be no necessity for removing the squares, with the idea that applications of poison alone would dispose of all the adult weevils.

According to the writer's observations, the late planting of cotton is dangerous, as the plants are so small and their root systems so poorly developed in June that it is almost impossible for them to produce a good crop of matured bolls before the annual migration of the weevil from untreated fields. It is better to plant the crop too early than too late. The larger the cotton plant at the time of taking off the squares the greater the amount of fruit it can put on within a few days afterward.

RELATION OF SQUARE STRIPPING TO YIELD

At first thought it may appear that a considerable amount of cotton would be destroyed or lost by removal of the first few squares, say, an average of about two large squares to the plant thruout the field. It has been demonstrated that the cotton plant normally sheds about 60 percent of its fruit during the growing season. Therefore, a loss of two squares to the plant, on the average, should not affect the yield.

It is true that heretofore the planter has attached great importance to these first squares, considering them the substance of his early bottom crop, and has pinned his crop prospects to the production of as many early bolls as possible, knowing that the weevil would not permit the maturing of later ones.

However, removal of the early squares in our experiments was followed by a remarkable reaction on the part of the plant itself. In all cases, removal of the squares was followed by a rapid increase in the height of the plants and this was closely followed by a profuse development of new squares. So pronounced has been this acceleration, or stimulation, of fruiting that it seems highly probable that, even with no weevils present, removal of all squares early in June would actually result in increasing the yield of cotton!

ACCELERATED FRUITING

The effect of square stripping, just described, may be likened in a sense to the stimulation of growth which follows the pruning of a perennial plant or shrub, such as the peach or apple, and it is to be remembered in this connection that in tropical coun-

tries the cotton plant is a perennial and attains the size of a very large shrub. Cotton is an annual in the United States only because it is killed by frost.

We do not know of any other instance of plant behavior with which this phenomenon of accelerated fruiting can be compared. A somewhat comparable reaction to pruning is evident, however, in the case of okra, which belongs to the same family. The growing and fruiting habits of cotton and okra are similar in many respects. It is well known to gardeners generally that if the first-appearing pods of okra are allowed to mature their seed, the fruiting is greatly retarded. In other words, to secure a bountiful supply of green pods, it is essential that all pods be frequently pruned from the plants.

A somewhat analogous condition exists in the case of the cotton plant. If the first few squares that come on the plant are allowed to set bolls and mature them, it is well into July before there is much indication of a middle crop being set and August before the top crop appears. It seems that while the plant is devoting its energies to forming the lint and seed in the lower bolls there is little tendency to produce additional squares and blossoms. Fertilizer may be so used as to greatly stimulate the rate of setting of the three so-called crops and, within certain limits, can be used to hasten it.

In order to determine with a fair degree of accuracy the extent of stimulation of fruiting which follows removal of the squares, an experiment was made in which six varieties of upland cotton were utilized. The cotton was planted March 20 in well-prepared seedbeds. Kainit and nitrate of soda were applied at the rate of 100 pounds of each to the acre. The land was well-drained and typical of the Norfolk sandy soils of Madison County. All six varieties were given the same cultivation and treated alike in every respect thruout the season.

On June 7 the first blossoms were just making their appearance and it was decided to remove all squares from one row of each variety and leave the adjacent row as a check. Beginning on June 8 and continuing until July 16, the number of blossoms produced by the stripped and non-stripped rows each day was recorded. By the latter date the boll weevils had increased in the field to such an extent as to interfere with the development of blossoms and the observations were discontinued. The rate of blossoming of both the stripped and non-stripped plants, in the case of the six varieties, is shown in Table 2.

TABLE 2.—RECORD OF DAILY BLOSSOMING BY SIX VARIETIES OF COTTON, MADISON, FLORIDA, 1922

Date of Examination	NUMBER OF BLOSSOMS											
	King		Lewis 63		Meade		Council Toole		DeSoto		Lightning Express	
	66 Plants Stripped*	62 Plants Non-stripped	82 Plants Stripped*	85 Plants Non-stripped	91 Plants Stripped*	89 Plants Non-stripped	90 Plants Stripped*	86 Plants Non-stripped	94 Plants Stripped*	83 Plants Non-stripped	31 Plants Stripped*	44 Plants Non-stripped
June 8	0	10	0	6	0	4	0	11	0	8	0	4
June 9	0	4	0	14	0	7	0	11	0	9	0	12
June 10	0	6	0	12	0	6	0	10	0	10	0	9
June 11	0	7	0	10	0	11	0	12	0	11	0	10
June 12	0	9	0	7	0	15	0	15	0	8	0	11
June 13	0	11	0	12	0	15	0	13	0	13	0	11
June 14	0	12	0	11	0	11	0	21	0	10	0	19
June 15	0	13	0	14	0	16	0	14	0	10	0	21
June 16	0	15	0	17	0	21	0	12	0	11	0	26
June 17	0	13	0	16	0	20	0	15	0	12	0	29
June 18	0	12	0	19	0	21	0	17	0	15	0	18
June 19	0	14	0	21	0	16	0	14	0	14	0	16
June 20	0	15	0	27	2	15	2	9	2	12	1	14
June 21	1	4	0	9	0	13	0	6	0	11	1	11
June 22	1	10	1	13	6	16	2	9	1	9	6	14
June 23	9	16	5	13	6	22	2	11	6	8	2	20
June 24	19	38	19	42	33	53	37	10	11	29	2	49
June 25	21	25	20	32	33	35	39	26	22	25	3	22
June 26	23	23	19	29	35	30	42	31	26	29	4	14
June 27	16	16	20	18	25	27	24	21	22	21	10	21
June 28	33	22	34	31	41	33	44	39	40	30	24	17
June 29	50	50	75	75	75	60	58	38	49	38	40	20
June 30	94	98	80	80	76	56	56	44	98	85	56	49
July 1	96	93	74	72	72	61	92	76	112	111	29	27
July 2	67	42	79	71	88	79	73	73	90	67	30	23
July 3	58	61	121	81	95	70	122	116	116	75	27	42
July 4	60	35	80	86	85	78	96	73	84	68	34	19
July 5	60	39	70	76	72	68	86	71	80	66	26	17
July 6	62	42	59	53	72	63	86	70	84	68	30	21
July 7	61	38	67	64	74	64	96	73	78	56	45	24
July 8	88	59	92	44	83	53	97	69	130	82	42	29
July 9	82	35	85	46	78	52	86	62	96	61	36	21
July 10	70	28	75	51	79	49	95	59	90	44	30	16
July 11	68	30	70	53	85	65	103	95	80	61	32	11
July 12	41	27	72	46	55	38	103	90	89	51	18	8
July 13	34	11	51	39	54	38	93	57	97	57	27	5
July 14	34	14	27	8	30	12	35	20	53	23	7	13
July 15	27	20	38	29	52	24	65	33	64	33	17	4
July 16	28	15	27	13	27	7	53	24	44	13	14	4
Totals	1203	1032	1360	1360	1433	1344	1687	1470	1664	1364	593	722
Average No. Blossoms per Plant	18.2	16.6	16.5	16	15.7	13.8	18.7	17.09	17.7	16.4	18.9	16.6

*All squares removed on June 7.

Table 2 shows that the non-stripped plants, producing blossoms from June 8 to July 16, did not produce as many to the plant as did the stripped plants, the latter having only from June 20 to July 16 in which to fruit. When the stripped plants began to square they soon caught up with and passed the non-stripped plants in the rate of blossoming. The non-stripped plants during this period were forming seed and lint in the bottom bolls and were not producing squares to any marked extent.

Reference to Table 3 shows that the stripped plants produced a daily average of .626 blossoms to the plant, while the non-stripped ones produced an average of .41 blossoms.

TABLE 3.—AVERAGE NUMBER OF BLOSSOMS TO THE DAY ON STRIPPED AND NON-STRIPPED PLANTS

Number plants stripped	Number plants not stripped	Blossoming period, stripped rows, days	Blossoming period, non-stripped rows, days	Total number blossoms produced, stripped rows	Total number blossoms produced, un-stripped rows
454	449	28	39	7,940	7,292
Average, daily				283	187
Daily average to the plant				.62	.41

Table 4 shows the number of blossoms produced each day on the total of 454 plants which were stripped of their squares on June 8 and on the total of 449 plants which did not have the squares removed. For purposes of ready comparison, the average blossoms to the plant for each day, in case of both stripped and unstripped plants, is also shown. It will be noted that from the time (June 20) the stripped plants began putting on squares, only eight days elapsed until these plants were producing squares faster than the plants from which no squares had been removed.

It is also interesting to note that the blossoming rate of the stripped plants did not fall off as quickly as did that of the check plants. The daily blossoming rate of these two groups of plants is shown graphically in figure 1.

On July 16 the bolls on both these lots of plants were counted. It was found that on the 454 plants which had been stripped of their squares on June 8 there were 4,846 bolls, or an average of 10.7 bolls to the plant; while on the 449 plants which had not been stripped there were 4,549 bolls, or an average of 10.1. This presaged a slight difference in production. The stripped plants

yielded at the rate of 841.4 pounds of seed cotton to the acre and the non-stripped yielded at the rate of 769.5 pounds, a difference of 71.9 pounds in favor of the former.

TABLE 4.—DAILY AVERAGE OF BLOSSOMS TO THE PLANT ON STRIPPED AND NON-STRIPPED PLANTS

	Number of Plants		Number of Blossoms			
Date	Stripped	Non-stripped	Stripped	Daily average stripped plants	Non-stripped	Daily average, non-stripped plants
June 8	454	449			43	.09
June 9	454	449			57	.12
June 10	454	449			53	.11
June 11	454	449			61	.13
June 12	454	449			65	.14
June 13	454	449			75	.16
June 14	454	449			84	.18
June 15	454	449			89	.19
June 16	454	449			102	.22
June 17	454	449			96	.21
June 18	454	449			102	.22
June 19	454	449			95	.21
June 20	454	449	7	.015	92	.20
June 21	454	449	2	.004	54	.12
June 22	454	449	17	.037	71	.15
June 23	454	449	30	.07	90	.20
June 24	454	449	121	.27	221	.49
June 25	454	449	138	.30	165	.36
June 26	454	449	149	.32	156	.34
June 27	454	449	117	.25	124	.27
June 28	454	449	216	.47	172	.38
June 29	454	449	347	.76	291	.64
June 30	454	449	460	1.00	412	.92
July 1	454	449	475	1.04	440	.98
July 2	454	449	427	.94	355	.78
July 3	454	449	539	1.18	445	.99
July 4	454	449	439	.96	359	.79
July 5	454	449	394	.86	337	.75
July 6	454	449	393	.86	317	.70
July 7	454	449	421	.92	319	.71
July 8	454	449	532	1.17	336	.74
July 9	454	449	463	1.01	277	.61
July 10	454	449	439	.96	247	.55
July 11	454	449	438	.96	315	.70
July 12	454	449	378	.83	260	.58
July 13	454	449	356	.78	207	.46
July 14	454	449	186	.40	150	.33
July 15	454	449	263	.58	142	.31
July 16	454	449	193	.42	76	.16
			7,940		7,352	

In this field of one acre, no steps other than the stripping of the six rows had been taken to control the weevil, with the result that a heavy infestation was reached by the middle of

July and many of the smaller bolls on the stripped plants were injured by the weevils. Had treatment for control of the weevil been given to the entire field it is likely that many of these bolls would have fully matured, thus increasing the difference in yield.

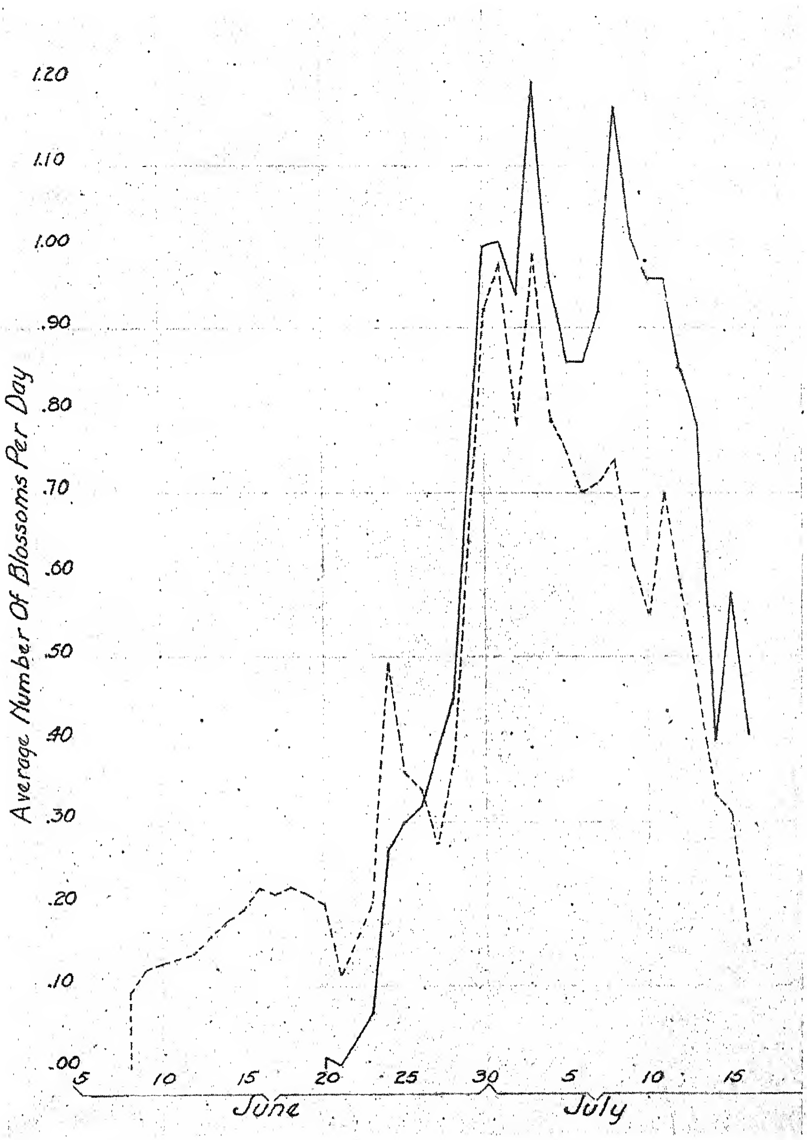

Fig. 1.—Chart showing blossoming rate of stripped (heavy line) and non-stripped (dotted line) cotton plants (original)

The results of this experiment are presented as showing that the removal of the first squares of the season not only does not reduce the normal crop but actually seems to increase it; and that such a result would apparently follow square-stripping as described, even if there were no boll weevil infestation.

SETTING A BOTTOM, MIDDLE AND TOP CROP IN 30 DAYS

The data just given point to one of the most satisfactory phases of the improved method of boll weevil control. Following the removal of the squares from the plants on June 7, rapid growth took place for a few days, which in turn was followed by the appearance of squares from bottom to top.

Therefore, it appears that by removing the first few squares, one may force the plants to set the three "crops" at approximately the same time, or between about June 20 and July 20. Figure 2 shows the profuse and uniform development of squares under these conditions.

RELATION OF SQUARE REMOVAL TO MATURITY OF CROP

As would be expected, removal of the first squares of the season results in the appearance of the first open cotton from ten to fifteen days later than would otherwise be the case. Therefore, as practically all the bolls for the crop are set between about June 20 and July 15 and as each boll opens in approximately 40 days, it follows that the entire crop opens between about July 30 and September 1.

This condition not only permits the cotton grower to harvest his crop with two, or at most three, pickings, but it also enables him to complete the harvest in ample time to destroy all the cotton plants by October 1—a most effective measure for reducing the number of weevils that can go into hibernation and that must be dealt with the following spring.

RELATION OF THE WEEVIL'S LIFE HISTORY TO CONTROL

An accurate knowledge of the weevil's life history under Florida conditions is very necessary to a satisfactory application of the control measures. A bulletin[8] by the writer, published in 1921, contains detailed accounts of the insect's life history, as determined by obeservations made in cotton fields in Madison County. Substantially, the life history was found to be as follows:

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[8]Bulletin 926, U. S. D. A.

The boll weevil passes the winter as an adult. With the first warm days of spring the weevils gradually emerge from their hibernating places in moss, leaves, trash, etc., and seek the cotton fields. The adults feed first upon the leaves of the young cotton plants and then upon the growing tips until the first squares appear. With the development of the squares, eggs are immediately deposited in them by the female weevils.

Under the temperatures prevailing in North Florida in early summer, an average of 21.9 days elapses between the depositing of the egg in the square and its development, thru larval and pupal stages, into the adult. The female does not become sexually mature and capable of depositing eggs until an average of 7 days after she emerges from the infested square. For example, a total of 30 days must elapse before an egg, deposited on June 5, can develop into an adult female capable of depositing eggs.

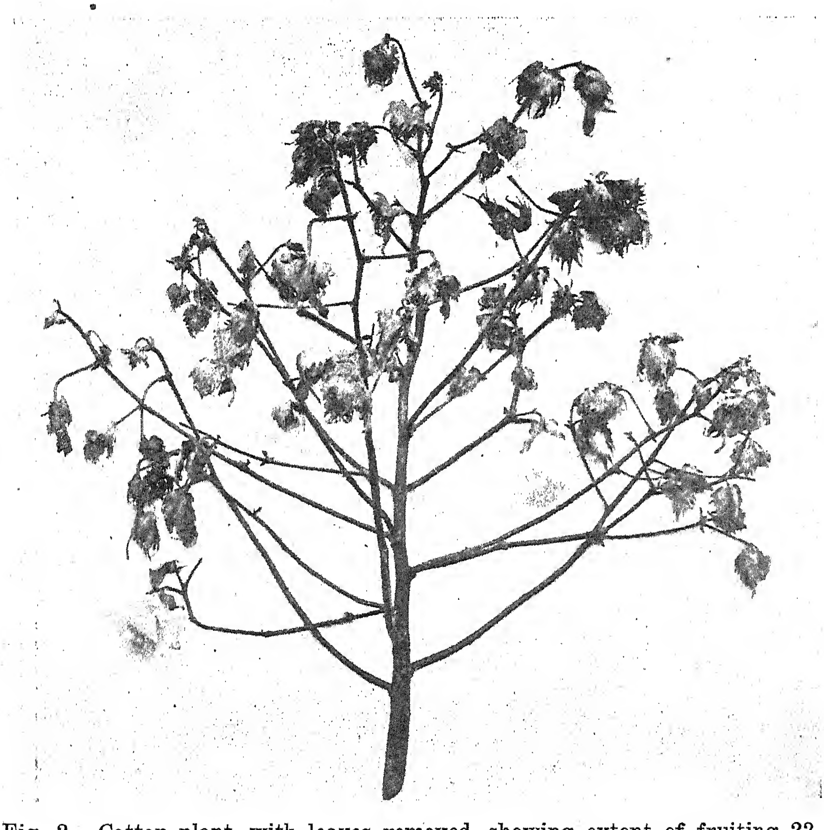

Fig. 2.—Cotton plant, with leaves removed, showing extent of fruiting 22 days after removal of all squares (original)

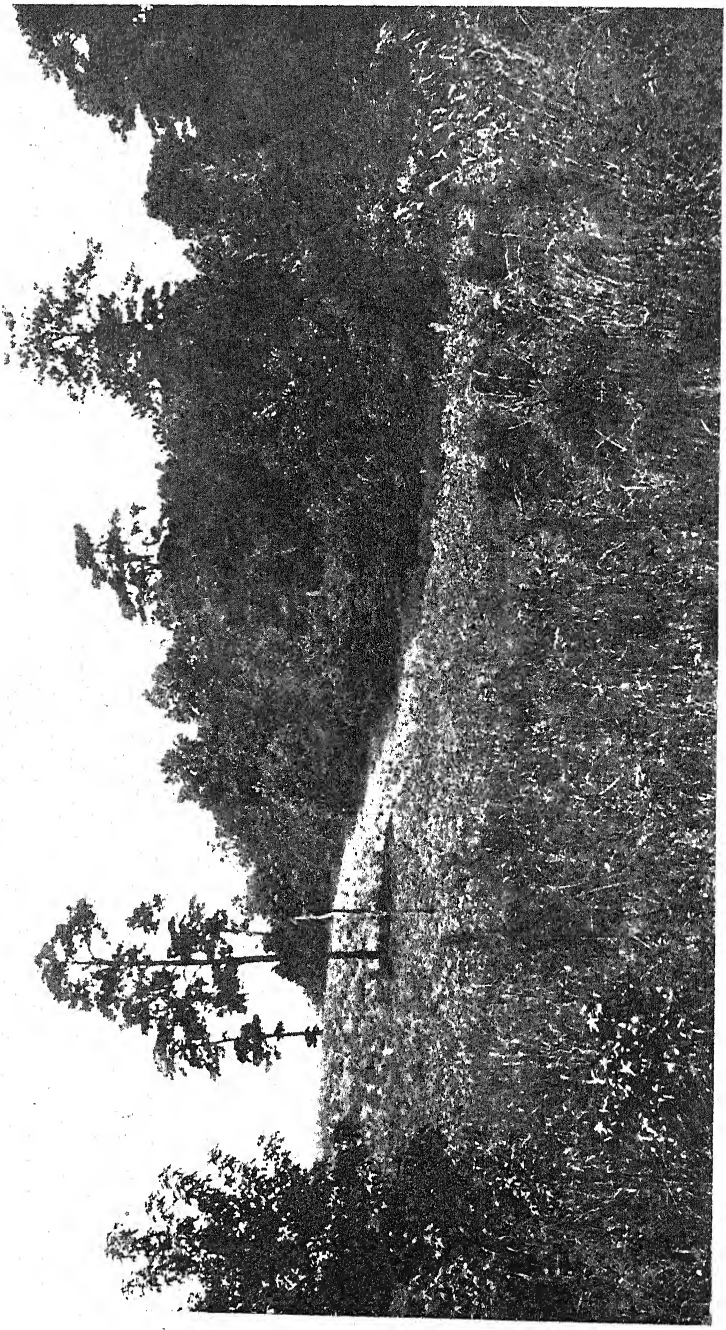

Fig. 3.—Typical surroundings of a cotton field in Madison County, showing favorable hibernating quarters for the boll weevil (field No. 5, Sanders Plantation)

Certain climatic conditions, such as prolonged dry weather, may operate to greatly lengthen this period but, for all practical purposes, 30 days may be considered as the necessary time for the development of a generation of weevils; and not 10 to 15 days, as many cotton planters have come to believe.

Males and females are produced in about equal numbers, the male being slightly smaller than the female as a rule. Both males and females feed on cotton bolls and squares, the puncture by either sex causing the square to flare and drop off.

The female usually deposits only one egg in a square but in late summer, when maximum infestation is reached and all squares are punctured, several are frequently deposited in a single square.

HIBERNATION

Where the cotton plants are allowed to remain standing, a few weevils may develop during the winter months from squares and bolls which became infested late in the season. However, with the advent of cool weather, or the first killing frost, the bulk of the weevils leave the cotton field and fly in various directions. Sooner or later they find shelter, as along fencerows or in the woods. Spanish moss, suspended in the forest trees, affords them most excellent protection during the winter. Typical quarters for weevil hibernation are shown in figures 3 and 4.

The weevils are frequently active during the winter in Florida. In fact, hibernation is seldom complete under Florida conditions. The number of weevils surviving the winter in Florida is possibly as great as anywhere in the South. An extensive hibernation test in cages at Madison in 1918-19 indicated that an average of 7.54 percent lived thru the winter.

Emergence from hibernation often commences in Florida during January. The weevils come out of their winter quarters gradually, the rate of emergence depending largely upon the temperature and amount of rainfall.

As shown elsewhere in this paper, the emergence from hibernation in Florida is, for all practical purposes, complete by about June 5. A few stragglers may emerge after this date but they are too few to cause injury of any consequence during early and mid-summer.

THE EXPERIMENTS OF 1922

As a result of the experimental work mentioned in the preceding pages the idea was conceived of combining square-stripping and poisoning as a means of controlling the weevil and increasing the yield of cotton. In order to test this theory under farm conditions, plans were made and carried out for making observations on relatively large scale field-tests during 1922.

These experiments were located near the towns of Madison, Live Oak, Wellborn, Gainesville and Hawthorne. Both upland and sea-island cotton were included in the tests. Only the results with upland cotton are discussed in this bulletin, as the acreage of treated sea-island was too small to permit of reliable conclusions.

All of the tests were located in fields where conditions were apparently very favorable for the boll weevil.

Briefly stated, the object of these experiments was to determine whether removal of the first squares, followed immediately by one application of poison, would dispose of practically all weevils in the field and, if so, whether weevil damage thereafter could reach the point where production of cotton would be seriously interfered with.

It may be stated at this point that the removal of all squares on or after June 5, followed by one thoro application of lead arsenate or calcium arsenate at the rate of from five to seven pounds to the acre, resulted in not more than an average of one weevil to the acre being left in the fields. Even if this weevil should happen to be a female and commence depositing eggs immediately, the first generation of her offspring would not reach maturity and deposit eggs before about July 5. The number of squares punctured by this generation would hardly offset the natural shedding of the plants. The second generation could not mature before about August 5 and, while it is granted that this generation might consist of many weevils, it must be remembered that the Florida crop of short staple is, by this date, "made" and sufficiently matured that practically no damage from the weevil can take place.

MANNER OF MAKING FIELD TESTS

In testing any method of control, it is essential that the field conditions be as nearly typical as possible. It is only by such field experiments that profit or loss, resulting from the control operations, can be determined.

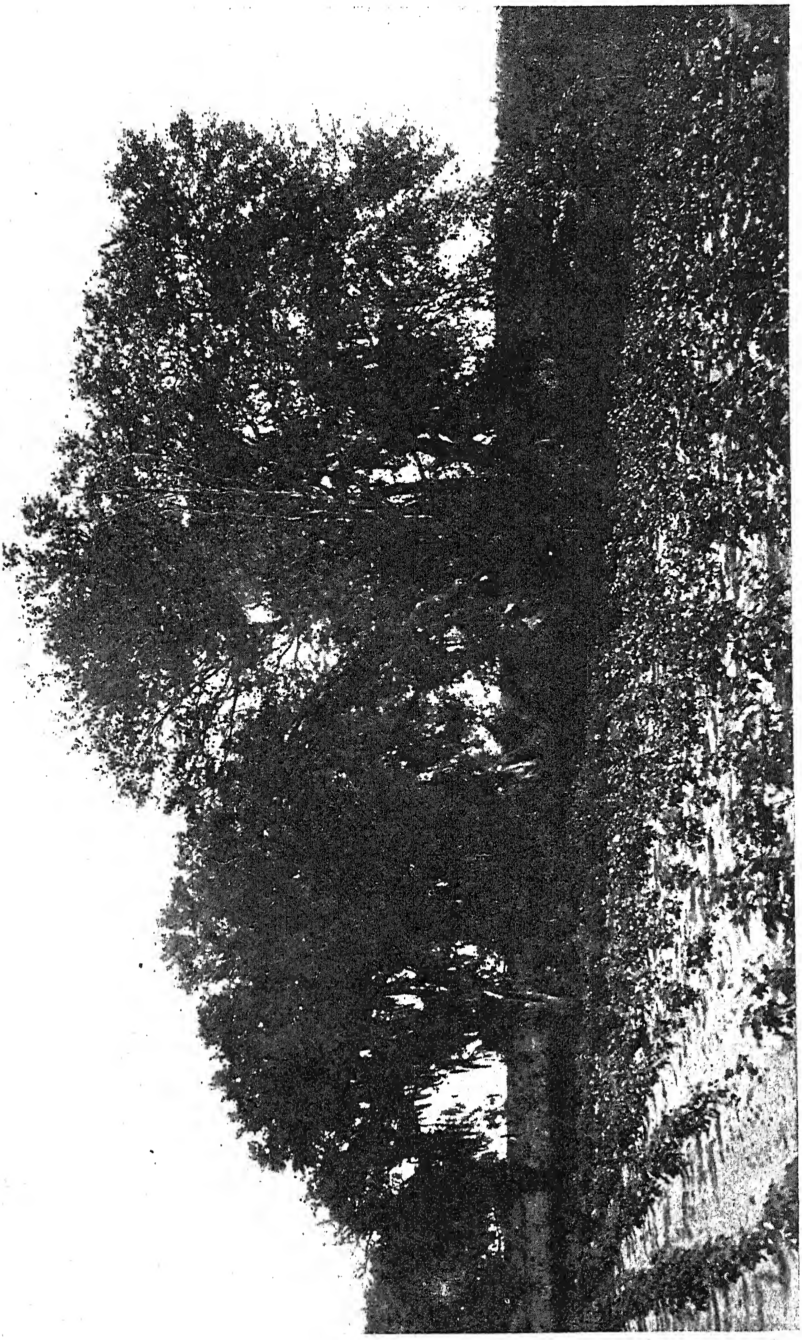

Fig. 4.—Moss-covered oaks at edge of cotton field. Boll weevils survive the winter in large numbers where such conditions exist (original)

In the experiments herein described, certain fields were treated to control the weevil while others were left untreated for comparison. Not all fields were treated on the same date, however. The fields, both treated and non-treated, were selected so that surrounding weevil-hibernating quarters, drainage and soil conditions would be as nearly alike as possible.

Measurements were made of all fields and plots. In Madison and Suwannee Counties these surveys were made by Chas. S. Wadsworth[9], of Madison. The cotton picked from each field was kept separate and carefully weighed and recorded. Arrangements were made with the owners to plant the fields on the same dates as far as possible, and to cultivate them in the same manner thruout the season.

MANNER OF APPLYING THE POISON

The machine used in our experiments was a hand duster of a well-known make, which forces the poison thru the nozzle with a current of air. On account of its being operated by hand the nozzle can be manipulated in such a manner as to force some of the poison into the terminal bud of each plant.

Other methods of applying the poison, such as dusting from sacks and distributing "broadcast," were tried but none gave satisfactory results. On account of the boll weevil's habit of feeding in the terminal buds when there are no squares present, any machine used for applying the poison must in some manner force the poison into these feeding places.

INFESTATION RECORDS

The percentage of punctured squares in a cotton field offers reliable data for determining the extent of infestation by the weevil. If only a small percentage of the squares are punctured during June and July, a good crop, all other things being equal, may be expected. On the contrary, a heavy infestation during early summer is always followed by a greatly reduced yield.

Removing or stripping the squares from the plants early in June results in the absence of all squares for a few days and of punctured squares for a considerable period. However, within five to seven days after stripping, new squares take the place of those removed. In the method of control used in these experiments, stripping is followed by poisoning. Any weevils not destroyed by this dual treatment proceed to attack these new

[9]Registered Civil Engineer No. 106, State of Florida.

squares. The percentage of infestation following the treatment shows its effectiveness as well as the rate of increase of any weevils that have not been destroyed.

For convenience, the records of infestation used in this bulletin were based upon an examination of 200 squares in each of three representative places in each field at intervals of 15 days. All squares on a plant were examined and counted and when 200 squares had been inspected the number of weevil-punctured ones was recorded. This count was repeated until a total of 600 squares had been examined in each plot.

The first examinations were deferred until July 1 in order that any weevils missed by the control operation might have time to establish an infestation that could be quite readily found.

HOW "PROFIT" OR "LOSS" IS DETERMINED

Any successful method of controlling the weevil must not only increase the yield but must also result in sufficient increase to more than offset the cost of using it. The cost of removing the squares from the plants, of the labor for applying the poison and of the poison itself must be deducted from the value of the increased production to determine accurately what has been accomplished by using the control method.

In the experiments described herein the value of labor by women and children in removing squares is estimated at the prevailing local rate of $.60 a day of ten hours or $.06 an hour, while the adult male labor used in applying the poison is estimated at $1 a day or $.10 an hour. The wages paid for ordinary farm labor vary in different sections of the state and this will, of course, cause a corresponding variation in the profit secured by controlling the weevil in this way.

The cost of calcium arsenate is calculated at $.10 a pound. This is about the maximum retail price for this material in Florida during 1922. It is to be expected that the price will increase slightly in the near future.

Altho we have not included the cost of using dust guns in estimating the cost of weevil control in the experiments herein described, this item must be considered. A good hand duster for applying the poison is absolutely essential. A good one can be bought for about $10 and with proper care and handling will last several seasons. Under average conditions the annual acre cost for dust-gun investment and depreciation should not exceed $.25.

PLOT EXPERIMENTS

EXPERIMENTS ON THE SANDERS PLANTATION

These experiments were located on the E. Sanders plantation five miles southwest of Madison, on Orangeburg sandy soil. According to all information available, the land had been in cultivation from 50 to 60 years.

Hibernating quarters for the boll weevil were abundant, the plantation being dotted with large trees heavily laden with Spanish moss, as shown in figure 4. Cotton had been grown on the plantation in 1921 and some of the 1922 plots were located in fields which were in cotton the preceding year. No fertilizer was used.

With the exception of treated field No. 5, all the fields were planted, the last week in March, to Lewis 63, an upland variety bred by the Georgia State Board of Entomology for its resistance to wilt[10]. Field No. 5 was planted to mixed seed of the upland type.

The planting, cultivating and picking of all fields were done by a negro tenant, Jake DeLaughter, the weighing of the cotton being supervised and checked by the writer or an assistant. Treatment for control of the boll weevil was supervised by the writer. The untreated cotton used as a check was grown by a colored tenant, Boswell Johnson.

In the experiments there were five cotton fields treated to control the weevil and one left untreated for comparison.

In all of the plots, except the check, the plants were stripped of all squares May 29 to 31 and had calcium arsenate applied June 1 and 2.

Inspections of all fields were made by Plant Board employees on July 1, July 15, August 1 and August 15 and the percentage of weevil infestation determined. The results of these examinations are given in Table 5.

Field No. 1

Field No. 1 consisted of 1.85 acres. The squares were picked from the plants on May 29 and the poison applied on June 1. The cost of treatment was:

Labor, picking off squares, 12 hours at $.06	$ .72
Labor, applying poison, 4 hours at $.10	.40
Calcium arsenate, 9.25 lbs. at $.10	.93
Total	$2.05
Cost, an acre	$1.11

[10]*Neocosmospora vasinfecta* (Atk.), Smith.

The treated plot of 1.85 acres produced 660 pounds of seed cotton or 356 pounds to the acre, while the check plot of 3.27 acres produced 350 pounds or an average of 107 pounds to the acre. This difference in yield is shown as follows:

Treated	356 lbs. to the acre
Non-treated	107 lbs. to the acre
Increase in production, treated field	249 lbs. to the acre

On the basis of current prices, this increase in yield is valued as follows:

83 lbs. lint at $.21 a pound	$17.43
166 lbs. seed at $32 a ton	2.65
Total	$20.08

The cost of treatment was $1.11 to the acre and by deducting this from the value of the increase in production we find that a profit of $18.97 to the acre resulted from the control operation.

The treated plot had a much poorer stand than the check plot and, on account of heavy rains following the removal of the squares on May 29, application of the poison was not possible until June 1, whereas for best results it should have been applied the same day.

Field No. 2

This field contained 3.89 acres and was located about one hundred yards south of the plot just described. Along its east side was a highway shaded by moss-covered trees, while underbrush and large trees occurred around a pond just west of the field.

The squares were picked from the plants on May 30 and poison applied on June 2. The cost of the dual treatment was:

Labor, picking off squares, 38.5 hours at $.06	$2.31
Labor, applying poison, 8 hours at $.10	.80
Calcium arsenate, 19.25 lbs. at $.10	1.93
Total	$5.04
Cost, an acre	$1.30

The treated field produced 2,038 pounds of seed cotton or 524 pounds to the acre. A comparison between it and the check plot is thus made:

Treated	524 lbs. to the acre
Non-treated	107 lbs. to the acre
Increase in production, treated field	417 lbs. to the acre

The value of the increase in cotton secured, due to the control operations, was:

139 lbs. lint at $.21	$29.19
278 lbs. seed at $32 a ton	4.44
Total	$33.63

Deducting from this the cost of treatment ($1.30), the profit from controlling the weevil in this experiment was $32.33 to the acre.

Field No. 3

Field No. 3 consisted of 2.02 acres and adjoined Field No. 2.

All squares were removed on June 1 and poison applied on June 2. The cost of this work was as follows:

Labor, picking off squares, 20 hours at $.06	$1.20
Labor, applying poison, 4 hours at $.10	.40
Calcium arsenate, 10 lbs. at $.10	1.00
Total	$2.60
Cost, an acre	$1.28

The 2.02 acres produced 1,044 pounds of seed cotton and its production is compared with that of the check in the following manner:

Treated	516 lbs. to the acre
Check	107 lbs. to the acre
Increase in production, treated field	409 lbs. to the acre

The value of this increase is arrived at thus:

136 lbs. lint at $.21	$28.56
273 lbs. seed at $32 a ton	4.36
Total	$32.92

By deducting the cost of treatment ($1.28) from the above figure it is seen that control of the weevil in this field gave a profit of $31.64 to the acre.

Field No. 4

The field contained 3.76 acres and was surrounded by corn fields, tho not over 200 yards from good weevil-hibernating quarters. A heavy rain storm shortly after planting resulted in severe damage and the stand secured in this field was later determined by an actual count of the plants to be only 44 percent of normal.

The squares were stripped from the plants on June 1 and the poison applied June 2. The cost was:

Labor, picking off squares, 37 hours at $.06	$2.22
Labor, applying poison, 8 hours at $.10	.80
Calcium arsenate, 19 lbs. at $.10	1.90
Total	$4.92
Cost, an acre	$1.31

Despite its poor stand, the treated field produced 857 pounds of seed cotton or 228 pounds to the acre. In making the following comparison between its yield and that of the check it should be remembered that the check plot had about 90 percent of a normal stand.

Treated	228 lbs. to the acre
Non-treated	107 lbs. to the acre
Increase in production, treated field	121 lbs. to the acre

The value of this increase is arrived at in this manner:

40 lbs. lint at $.21	$8.40
81 lbs. seed at $32 a ton	1.29
Total	$9.69

Deducting the cost of treatment ($1.31), we see that control of the weevil gave a profit of $8.38 to the acre, even tho the field receiving the treatment was handicapped by storm damage and a very poor stand.

Field No. 5

The conditions under which the improved method of control was tested in this plot were unusually severe. No particular variety of cotton was used: the tenant had merely planted "cotton," mixed seed of unknown varieties. The field, containing 2.24 acres, was in the form of a rectangle and was bordered on the west by a dense swamp (see figure 3) which had afforded ideal hibernating quarters for the weevils produced in cotton grown on the same field the previous year. The land in this field is rolling and perhaps slightly more fertile than fields 1 to 4.

At the time the first squares appeared the colored tenant was much discouraged on account of the large number of weevils present and asked that he be allowed to plow up the cotton.

The squares and 730 visible adult weevils were picked from this plot on May 29, to say nothing of those which may have been within the involucres (or shucks) of the squares. No attempt was made to ascertain the total number of weevils removed in the square-picking process, but it is likely that fully 1500 were taken off. Poison was applied June 1. The cost of picking off squares and applying the poison was as follows:

Labor, picking off squares, 30 hours at $.06	$1.80
Labor, applying poison, 5 hours at $.10	.50
Calcium arsenate, 15.6 lbs. at $.10	1.56
Total	$3.86
Cost, an acre	$1.72

The treated field produced 850 pounds of seed cotton or 379 pounds to the acre, which was remarkable in view of the fact that there was hardly 50 percent of a stand. It was the consensus of opinion of those who followed the experiment carefully that, with the enormous number of weevils present in May, this field would have produced practically no cotton had the weevil-control treatment not been given. Its actual yield is compared with that of the check plot in the following manner:

Treated	379 lbs. to the acre
Non-treated	107 lbs. to the acre
Increase in production, treated field	272 lbs. to the acre

The value of the increase is thus determined:

90.6 lbs. lint at $.21	$19.02
181.4 lbs. seed at $32 a ton	2.90
Total	$21.92

From the value of this increase should be deducted the cost of treatment ($1.72), which gives $20.20 to the acre as the profit resulting from controlling the boll weevil.

Infestation Record, Sanders Plantation

The data concerning the percentage of infestation by the weevil in the check field and the five treated fields on the Sanders plantation is presented in Table 5.

TABLE 5.—PERCENTAGES OF INFESTATION, SANDERS PLANTATION

	July 1	July 15	Aug. 1	Aug. 15
Check field	14.00	70.00	89.9	100.0
Treated fields:				
No. 1	0.8	11.0	57.0	85.0
No. 2	0.9	0.12	66.0	86.0
No. 3	0.01	3.6	68.0	79.0
No. 4	0.01	5.0	80.0	91.0
No. 5	0.4	13.0	88.0	95.00
Average infestation, treated fields	0.4	6.5	75.1	87.2

In practically all of the fields described herein, it will be noted that the infestation on August 1 was much higher than on July 15. The reason for this increase lies in the fact that the cotton in nearly all fields showed a very determinate habit of growth and that the crop was "made" by the middle of July. After this date nearly all the squares and, in many cases, the leaves, were shed. The result was a concentration of the weevils on a much smaller number of squares and this operated to increase the percentage of infestation.

TABLE 6.—SUMMARY OF RESULTS, SANDERS PLANTATION

Plot	Acres	Total yield, lbs. seed cotton	Yield, an acre	Yield of check plot, an acre	Increase, lbs., to the acre	Percent of increase	Value of increase to the acre	Cost of treatment to the acre	Profit, to the acre
Check	3.27	350	....	107	....	....	....	....	....
1	1.85	660	356	107	249	232	$20.08	$1.11	$18.97
2	3.89	2038	524	107	417	389	33.63	1.30	32.33
3	2.02	1044	516	107	409	382	32.92	1.28	31.64
4	3.76	857	228	107	121	113	9.69	1.31	8.38
5	2.24	850	379	107	272	254	21.92	1.72	20.20
Totals	13.76	5449	....	....	....	....	....	....	....
Averages	....		396*	107	289	270	23.30**	1.34	21.96

*Obtained by dividing total production by total acreage.
**Value of the 289 pounds.

EXPERIMENT BY A. HODGE

This experiment was of peculiar interest in that it was carried out by Mr. Hodge, a practical farmer living about four miles northeast of Madison without any supervision or help other than an oral description of the principles involved and the manner of giving the treatment.

Mr. Hodge had two fields of cotton. He treated one to control the boll weevil and left the other untreated.

The field selected for treatment contained 5.73 acres of high, well-drained Norfolk sandy soil. During the last week in March the field was planted to Lewis 63. One hundred pounds to the acre of an equal mixture of kainit and acid phosphate was applied at the same time.

Mr. Hodge had been advised to begin the weevil treatment on June 5 but, finding the hibernated weevils abundant in his field, he began May 25 to pick the squares and visible weevils from the plants. He completed this work on June 4. On June 5 he applied poison to 3.5 acres and, finding many weevils present (due to his having commenced stripping before all weevils were out of hibernation), he decided to again strip the squares from the remaining 2.23 acres. Therefore, this part of the field was given its second stripping on June 5 and 6 and the poison applied on these dates.

Mr. Hodge states that he and his two small boys did all of the square stripping in two days and that he applied four pounds of calcium arsenate to the acre in about one day. Upon this

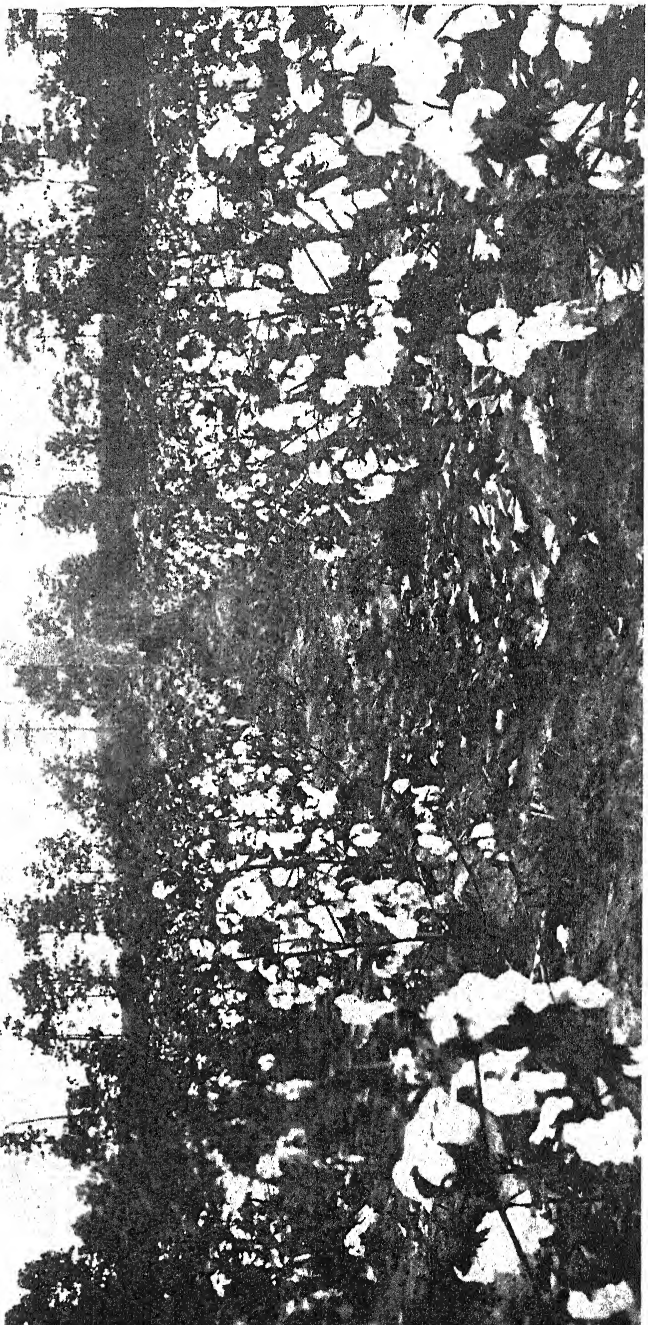

Fig. 5.—Normal cotton production secured by A. Hodge as a result of using the improved method of boll weevil control (original)

basis, the cost of treating his field was approximately as follows:

Labor, picking off squares	$2.50
Labor, applying poison	1.00
Calcium arsenate, 22.9 lbs. at $.10	2.29
Total	$5.79
Cost, an acre	$1.01

Mr. Hodge reports that in stripping the squares he captured 67 adult boll weevils in addition to whatever number may have been concealed within the squares. Following the stripping and application of poison Mr. Hodge examined plants in all parts of the field and found three weevils had been missed.

The 3.5 acres which were stripped of squares once yielded 1,683 pounds of seed cotton or 481 pounds to the acre. The 2.23 acres of cotton (which were stripped twice) produced 1,317 pounds, or 590 pounds to the acre. The entire field (5.73 acres) produced 3,000 pounds, or an average of 523 pounds to the acre. The appearance of this field at picking time is shown in figure 5.

The non-treated field, planted and grown by Mr. Hodge for comparison with the above contained .52 acre and yielded 58 pounds of seed cotton, or 111 pounds to the acre.

The following comparison between the yield of all the treated cotton, on the one hand, and of the non-treated on the other, may therefore be made:

Treated	523 lbs. to the acre
Non-treated	111 lbs. to the acre
Increase in production, treated field	412 lbs. to the acre

The value of this increase is found as follows:

137.3 lbs. lint at $.21	$28.83
274.7 lbs. seed at $32 a ton	4.39
Total	$33.22

From this must be deducted the cost of treatment, estimated, according to Mr. Hodge's figures, at $1.01 an acre, leaving $32.21 an acre as the profit which Mr. Hodge derived from controlling the weevil by this method.

Mr. Hodge states that the crop of upland cotton produced in his treated field was fully the equal of any he ever produced prior to the advent of the boll weevil.

A TEST IN SUWANNEE COUNTY

The method of weevil control described on preceding pages was tried by H. Wimberly in a small field of Meade cotton on

his farm 10 miles southwest of Live Oak. He is an extensive grower of sea-island cotton and his entire acreage was planted to sea-island with the exception of the field of Meade which received treatment.

This could hardly be considered a true experiment, inasmuch as there was no check or non-treated field for comparison with the treated one. It was more in the nature of an attempt to find out how much of a crop could be obtained in the face of the weevil infestation in that locality.

The field was on Norfolk sandy soil, well-drained, had been in cultivation for several years and was considered rather poor.

The cotton was planted on March 20 and about a hundred pounds to the acre of a home-mixed commercial fertilizer applied.

On May 29, under supervision of the writer, all squares were picked from the plants and calcium arsenate was applied the following evening at the rate of five pounds to the acre. Records of the cost of treating this field are incomplete but approximated \$1.50 to the acre.

Counts were made of squares in this field at intervals of 15 days during July and August and the following data obtained as to the weevil infestation:

Date	Infestation, percent
July 1	2.0
July 15	9.6
August 1	59.0
August 15	88.0

The above record shows that almost complete freedom from weevil damage was secured thru June and well into July.

This field contained 2.55 acres. The owner's records show a production of 1,560 pounds of seed cotton, an average of 611 pounds to the acre.

A TEST IN ALACHUA COUNTY

This was not a true experiment as, like the test just described, there was no check or non-treated field for comparison. It was, rather, an attempt to produce a crop of cotton on very poor soil, using the method of weevil control under investigation. The results of this test are of unusual interest in that the number of weevils in the field prior to treatment was definitely known. No cotton had been grown in the vicinity the year before and weevils were purposely placed in the field to insure a heavy infestation.

The field consisted of a two-acre plot on the grounds of the University of Florida Experiment Station. The land is sandy, well-drained and very deficient in plant food. Six hundred pounds to the acre of 8-3-3 fertilizer was applied on March 9, and DeSoto cotton planted on March 15.

Five hundred fifteen boll weevils were liberated in this two-acre cotton field between May 29 and June 2, furnishing an infestation which compares favorably with that usually found in the average cotton field at that time of year.

Owing to the experiments in other counties requiring the writer's attention, treatment of this field for weevils could not be given until June 8. As this season's experiments have shown, this field was also planted earlier than it should have been. As a result, the plants were larger and more advanced than was desirable and some bolls had already formed. However, on this date all squares, bolls and blossoms were stripped from the plants, and calcium arsenate applied. Because of the large size of the plants, it was necessary to apply the poison at the rate of 11 pounds to the acre. The large amount of fruitage removed and of poison required made the cost of treatment ($6.64 to the acre) abnormally high.

Because an employee of the Experiment Station failed to carry out instructions, this field received no cultivation from June 8 to June 30, the most critical period in the formation of the crop. By June 30 the plants were badly affected with bacterial wilt[11] ("rust"), appeared to have reached their full growth and had set an average of only one boll each. Any stimulation that may have resulted from the square-stripping had, by this time, apparently spent itself. At this stage nitrate of soda was applied to the field at the rate of 100 pounds to the acre and cultivation was resumed. The recovery of the plants was remarkable and during July they produced squares and blossoms rapidly.

Altho an examination of 300 picked and counted squares, on July 1, did not reveal any infestation, a few punctured squares, apparently the work of a single weevil, were found by carefully examining the entire field. It was evident that out of the 515 weevils positively known to be in the field prior to treatment, not more than one or two escaped.

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[11]*Bacterium malvacearum* E. F. Sm.

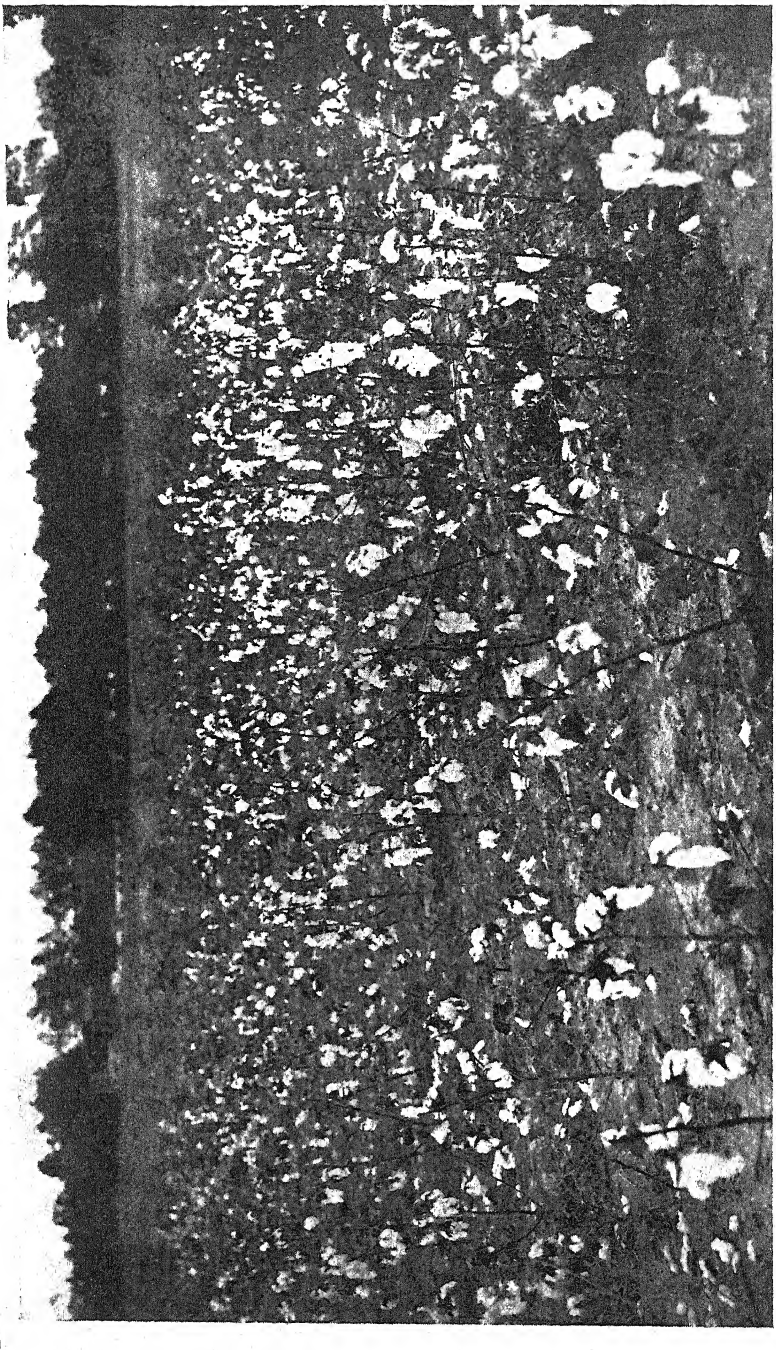

Fig. 6.—More than one-third of a bale to the acre on poor sandy soil. Made possible by controlling the boll weevil. Grown on Experiment Station farm at Gainesville (original)

The examinations made during July and August showed the progress of infestation to have been:

Date	Infestation, percent
July 1	0.0
July 15	6.2
August 1	60.0
August 15	90.0

The crop was picked during September under the supervision of A. W. Leland, farm foreman of the Experiment Station, and amounted to 1,100 pounds of seed cotton, or 550 pounds to the acre. The appearance of this field at picking time is shown in figure 6.

As already stated, this could not be regarded as a true experiment, as there was no way to ascertain the profit derived from the treatment. The test did show that, even on the poorest sandy soil, a fair crop of cotton can be made in spite of heavy weevil infestation. Practically the entire crop was made after July 1. Despite the fact that the field received no cultivation for 18 days at the most critical period, the yield secured would have been considered excellent on this type of land prior to the advent of the boll weevil.

The account of this test is given here because the observations corroborate, in some measure at least, the conclusions reached in the experiments proper.

A PLANTATION TEST

The reader who has followed the accounts, on preceding pages, of the experiments in relatively small cotton fields may be inclined to wonder whether the method of boll weevil control used therein is also applicable to large fields or under conditions which exist on typical cotton plantations.

The first reply to this question is that experiments made upon small areas, where all conditions are under the personal observation of the experimenter and where all operations can be quite definitely controlled, afford a much more crucial test than experiments made upon relatively large acreages. If a principle or method is correctly tested upon a small scale and found adequate, it may confidently be relied upon when used more extensively.

However, it was anticipated that this question would be asked and preparation was, accordingly, made to secure data with which to answer it. The opportunity came thru the courtesy of S. A.

Smith of Madison, who offered for experimental purposes the fields planted to cotton on his plantation in 1922.

This plantation, containing about 3,000 acres and located five miles south of Madison, is typical of many occurring in Florida in that most of the cleared land has been in cultivation for many years and is more or less impoverished. Little rotation of crops has been practiced. The plantation is divided into small areas, each of which is rented to a share tenant. In addition, the almost total destruction by the boll weevil of all cotton crops attempted on this place since 1916 assured a weevil infestation heavy enough to satisfy the most exacting requirements.

Numerous bay-heads and areas of dense forest abound on the plantation. Trees in the forest, as well as those around houses and along the fencerows and roads, are heavily laden with Spanish moss. These areas, together with uncultivated fields grown up to grass and weeds, afforded ideal hibernating quarters for the weevil.

Cotton grown in various fields on the plantation during 1921, with no effort made to destroy any of the cotton plants in the fall, furnished an abundance of weevils to enter hibernation and, consequently, large numbers to attack the crop this spring. The entire cotton acreage on the plantation in 1921 did not average over 50 pounds of seed cotton to the acre.

The land is more or less rolling, well-drained and mostly Orangeburg sandy loam. According to the owner, this land is capable of making, without fertilizer, an average of 400 pounds of seed cotton to the acre.

All cotton on the plantation in 1922 was grown by tenants or "half-croppers," each planting, cultivating and harvesting his own field. Owing to the heavy weevil damage experienced in preceding years, the owner of the plantation did not deem it safe to make advances of fertilizer to the tenants; but he did secure for them a supply of Lewis 63 seed.

Past experience with cotton growing under boll weevil conditions had not made the tenants at all enthusiastic and they did not exert themselves to secure satisfactory stands, or even, in some cases, to give their cotton reasonably good care and cultivation. With one exception the tenants were negroes.

The conditions under which the experiment was undertaken were, therefore, in every way representative of those existing on a typical plantation of the kind formerly given over mainly to the production of cotton under the tenant system.

The tenants were induced to plant their cotton during the last week in March, as it was believed that this would result in the plants being ready for treatment when practically all boll weevils had emerged from hibernation.

The work of removing squares and applying poison was done by the tenants themselves but, except where otherwise stated, was under the personal supervision of the writer or an assistant. As it was deemed advisable to apply the treatment to all fields at the same time, the tenants and their families were organized into one party which treated the fields successively.

The several crops were harvested by the tenants and all weights verified by Plant Board employees.

CHECK FIELDS

In testing any method on a plantation scale the object is to secure the most profitable crop possible over the entire acreage. However, the amount of profit derived from the weevil control operations cannot be definitely ascertained unless some fields are left untreated for comparison.

In this experiment there were two check fields available. One of these, known as check field No. 1, was just across the highway from the Smith plantation. Check field No. 2 was on the opposite side of the plantation. Soils, surroundings and other conditions with reference to these check fields were not noticeably different from those receiving the treatment.

Examination of all fields was made by Plant Board employees on July 1, July 15, August 1 and August 15 to determine the percentage of weevil infestation. The results of these examinations are recorded in Table 7.

Check field No. 1 (containing 3.27 acres) produced 350 pounds of seed cotton or 107 pounds to the acre. This was the same field that was used as a check for comparison with the treated fields on the Sanders place. Check field No. 2 (containing 2.26 acres) produced 449 pounds of seed cotton or 198 pounds to the acre.

The total acreage of the two check fields was 5.53 and the total production of the two was 799 pounds of seed cotton or an average production of 144 pounds to the acre.

In discussing the several treated fields, comparisons of yield are made, in some cases, between the treated and the check field located nearest to it. Where the treated field was not in close proximity to one of the checks, comparison is made with the average of the two check fields.

Fig. 7.—Full fruitage (bottom, middle and top crop) of cotton resulting from use of the improved method of weevil control (field of John Robinson, col.)

TREATED FIELDS

Field No. 1

John Robinson (col.), Tenant

This field of 14.93 acres was on land where the weevils had destroyed practically the entire crop in 1921. About four out of the 14.93 acres received a light application of barnyard manure during the winter of 1921-22. A very poor stand, approximately 60 percent of normal, was secured on about two-thirds of the field.

All squares were removed from the plants on May 28 but heavy rains delayed application of poison until June 1. By this time a few small squares had appeared and these doubtless permitted some of the weevils to escape.

The cost of treating this field was:

Labor, picking off squares, 130 hours at $.06	$7.80
Labor, applying poison, 30 hours at $.10	3.00
Calcium arsenate, 89.5 lbs. at $.10	8.95
Total	$19.75
Cost, an acre	$ 1.32

The field of 14.93 acres produced 9,100 pounds of seed cotton or 609 pounds to the acre.

The production is thus compared with that of the untreated field:

Treated	609 lbs. to the acre
Check	107 lbs. to the acre
Increase in production, treated field	502 lbs. to the acre

The value of this increase in production is estimated as follows:

167.3 lbs. lint at $.21	$35.13
334.7 lbs. seed at $32 a ton	5.35
Total	$40.48

Deducting the cost of treatment ($1.32) we find that the profit from controlling the weevil was $39.16 to the acre. Figure 7 shows a view of this field.

Field No. 2

"Parson" Brown (col.), Tenant

This field contained 4.81 acres and was located about 100 yards from where cotton had been grown in 1921. Corn fields were on three sides and dense woodland on one side. Treatment for the weevil was given by the tenant without supervision. The "parson" took his time in removing the squares and succeeded in

completing the operation between May 29 and June 8 and on the latter date he applied poison at the rate of five pounds to the acre, the estimated cost of treatment being:

Labor, removing squares, 40 hours at $.06	$2.40
Labor, applying poison, 6 hours at $.10	.60
Calcium arsenate, 24.05 lbs. at $.10	2.40
Total	$5.40
Cost, an acre	$1.12

The field produced 2,268 pounds of seed cotton, or 471 pounds to the acre, which makes possible the following comparison with the average production of the two check fields:

Treated	471 lbs. to the acre
Check fields	144 lbs. to the acre
Increase in production, treated field	327 lbs. to the acre

This increase of 327 pounds is valued as follows:

109 lbs. lint at $.21	$22.89
218 lbs. seed at $32 a ton	3.48
Total	$26.37

From the value of the increase in production ($26.37) must be deducted the cost of weevil treatment ($1.12) which shows an acre profit of $25.25 from the control operations.

Field No. 3

Lewis Frazier (col.), Tenant

This field of 22.49 acres was separated from field No. 2 by only a wire fence and was about 100 yards from where cotton was grown last year. Good weevil hibernating quarters abounded in all directions.

The squares were removed and poison applied June 4 and 5, the poison being applied as rapidly as the square-picking crew covered the field. The conditions under which the treatment was given were all that could be desired but the tenant became crippled on June 10 and the field was cultivated only once.

The cost of treatment was:

Labor, picking off squares, 160 hours at $.06	$9.60
Labor, applying poison, 50 hours at $.10	5.00
Calcium arsenate, 157.4 lbs. at $.10	15.74
Total	$30.34
Cost, an acre	$ 1.35

This field produced 7,632 pounds of seed cotton, or 339 pounds to the acre, while the two check fields averaged 144 pounds to the acre, thus affording this comparison:

Treated	339 lbs. to the acre
Check fields	144 lbs. to the acre
Increase in production, treated field	195 lbs. to the acre

This increase is valued as follows:

65 lbs. lint at $.21	$13.65
130 lbs. seed at $32 a ton	2.08
Total	$15.73

Deducting the cost of treatment ($1.35) we see that the acre profit amounted to $14.38, despite the lack of cultivation.

Field No. 4

Newton Mayhew (col.), Tenant

Field No. 4, containing 5.64 acres, was located just across the public highway from No. 3. The stand was very poor. An actual count of the plants showed the stand to be only 41 percent of normal.

On June 6 the squares were removed and poison applied. The cost was:

Labor, picking off squares, 56 hours at $.06	$3.36
Labor, applying poison, 12 hours at $.10	1.20
Calcium arsenate, 45 lbs. at $.10	4.50
Total	$9.06
Cost, an acre	$1.60

The production of field No. 4 was 2,290 pounds of seed cotton or 406 pounds to the acre. This is compared with the production of the check as follows:

Treated	406 lbs. to the acre
Check fields	144 lbs. to the acre
Increase in production, treated field	262 lbs. to the acre

The value of this increase is estimated as follows:

87.3 lbs. lint at $.21	$18.33
174.0 lbs. seed at $32 a ton	2.79
Total	$21.12

After deducting $1.60, the cost of treatment, it is seen that the weevil control operation gave a profit of $19.52 to the acre.

Field No. 5

Newton Mayhew (col.), Tenant

Ideal weevil hibernating quarters surrounded this field of 4.93 acres, and its soil appeared to be slightly better than the average of the other fields on the plantation.

On June 6 the squares were removed and poison applied. The cost was as follows:

Labor, picking off squares, 40 hours at \$.06	\$2.40
Labor, applying poison, 10 hours at \$.10	1.00
Calcium arsenate, 25 lbs. at \$.10	2.50
Total	\$5.90
Cost, an acre	\$1.19

The field produced 2,409 pounds of seed cotton, or 488 pounds to the acre. The stand was poor; an actual count of the plants showed the stand to be only 49 percent of normal. The actual yield is here compared with the average yield of the checks:

Treated	488 lbs. to the acre
Check fields	144 lbs. to the acre
Increase in production, treated field	344 lbs. to the acre

The value of this increase of 344 pounds is estimated as follows:

114.6 lbs. lint at \$.21	\$24.06
229.4 lbs. seed at \$32 a ton	3.67
Total	\$27.73

Deducting from this the cost of treatment (\$1.19), leaves \$26.54 to the acre as the profit resulting from weevil control.

Field No. 6

Bud Mayhew (col.), Tenant

Cotton had been grown during 1921 on a portion of this field of 3.05 acres and the field started off in 1922 with an abundance of weevils.

Squares were removed and poison applied June 7. A drizzling rain occurred just as the application of poison was finished but apparently the poison was not affected. The cost of treatment was:

Labor, picking off squares, 32 hours at \$.06	\$1.92
Labor, applying poison, 8 hours at \$.10	.80
Calcium arsenate, 18.3 lbs. at \$.10	1.83
Total	\$4.55
Cost, an acre	\$1.49

This field of 3.05 acres produced 1,385 pounds of seed cotton, an average of 454 pounds to the acre. This yield is compared with the average of the two checks, as follows:

Treated	454 lbs. to the acre
Check fields	144 lbs. to the acre
Increase in production, treated field	310 lbs. to the acre

The market value of the 310 pounds of seed cotton is arrived at in the following manner:

103.3 lbs. lint at $.21	$21.69
206.7 lbs. seed at $32 a ton	3.30
Total	$24.99

The value of the increase ($24.99), less the cost of treatment ($1.49), shows the profit to have been $23.50 to the acre.

Field No. 7

Bud Mayhew (col.), Tenant

Field No. 7, containing 11.57 acres, presented an unusual condition from the standpoint of weevil infestation. Immediately adjoining it was a field in which cotton grew last year and in which volunteer or stubble plants grew this spring. Examination of this field early in June showed that a generation of weevils had already developed and some of these had evidently drifted into field No. 7.

It was quite evident that removal of the weevils from the cultivated field would avail little if the weevil hatchery in the stubble cotton were allowed to remain. Therefore, we destroyed the stubble cotton and all fallen squares.

This field was one of the oldest, from point of cultivation, on the place and the soil was decidedly impoverished. Added to this handicap, the tenant gave the crop indifferent care and cultivation during the growing period.

On June 7 the squares were removed and one application of poison made, at a cost detailed as follows:

Labor, picking off squares, 110 hours at $.06	$6.60
Labor, applying poison, 25 hours at $.10	2.50
Calcium arsenate, 92.5 lbs. at $.10	9.25
Total	$18.35
Cost, an acre	$ 1.58

The field of 11.57 acres yielded 4,171 pounds of seed cotton, an average of 360 pounds to the acre. Its yield is, therefore, compared with the average yield of the two check fields in the following manner:

Treated	360 lbs. to the acre
Check fields	144 lbs. to the acre
Increase in production, treated field	216 lbs. to the acre

Calculation of the value of this increase is made thus:

72 lbs. lint at $.21	$15.12
144 lbs. seed at $32 a ton	2.30
Total	$17.42

Fig. 8.—Profitable crop of upland cotton secured by Arch Kelly as a result of applying the improved method of weevil control (original)

After subtracting from this figure the cost of treatment ($1.58), there remains $15.84 profit to the acre.

Field No. 8

Arch Kelly, Tenant

Mr. Kelly is a successful white farmer with many years of experience as a practical cotton grower. He was sufficiently interested in the efforts to find a satisfactory means of controlling the boll weevil to undertake the treatment, as directed, on his main field of 19.47 acres. This field was planted to Lewis 63 the last week in March and fertilized with 50 pounds of kainit to the acre. Mr. Kelly was, however, somewhat dubious about weevil control measures and, for his own observation and comparison, planted a nearby field (containing 2.26 acres), in which no effort was made to control the weevil.

Mr. Kelly supervised the treatment, from June 1 to 5, of his main field without assistance from Plant Board employees. He did not keep an accurate record of the time and material required but, from the size of his cotton at the time of treatment and the cost incurred in other fields, it seems safe to estimate the acre cost at $1.25.

The production in Mr. Kelly's treated field affords data for an interesting and significant comparison between the profit to be derived from controlling the weevil on good land, on the one hand, and poor land, on the other. The best land, consisting of 10.46 acres, produced 5,601 pounds of seed cotton, or 535 pounds to the acre. The remaining 9.01 acres, being poorer soil, produced a total of 3,067 pounds, or an average of only 340 pounds to the acre. Yet the acre cost of controlling the weevil in these two parts of the field was the same!

The non-treated field of 2.26 acres produced 449 pounds of seed cotton, an average of 198 pounds to the acre.

These data permit the following comparison of yields between the best and the poorest parts of the treated field and the check:

	Treated field, lbs. seed cotton to the acre	Check field, lbs. seed cotton to the acre	Increase due to weevil control, lbs. seed cotton to the acre
Good land	535	198	337
Poor land	340	198	142
Entire field	445	198	247

If the value of the increased production on the best land be computed at the rate of $.21 a pound for lint and $32 a ton for

the seed, it will be found to be $27.17. In like manner, the value of the increase of 142 pounds to the acre on the poorer land will be found to be $11.44. Deducting the cost of treatment ($1.25) in each instance we have $25.92 and $10.19, respectively, as the profit derived from the weevil-control operation on the good and the poor land. Figure 8 shows the production secured by Mr. Kelly on his best land.

It is admitted that the fertility of the soil in the check plot was perhaps comparable with that of the poorer portion of the treated field, rather than with that of the portion which produced at the rate of 535 pounds. However, this does not alter the significance of the figures; the treatment for boll weevil made it possible for the better land to produce in proportion to its ability. The better the land and the better the care the crop receives, the greater the profit from controlling the weevil.

The comparison between the production of all Mr. Kelly's treated and non-treated cotton is made in this way:

Treated	445 lbs. to the acre
Non-treated	198 lbs. to the acre
Increase in production, treated field	247 lbs. to the acre

This average increase in production is valued as follows:

82.3 lbs. lint at $.21	$17.28
164.7 lbs. seed at $32 a ton	2.63
Total	$19.91

Deducting the estimated cost of treatment for the weevil ($1.25), there remains $18.66 to the acre as the profit derived by Mr. Kelly from the control operations on his entire field of 19.47 acres.

Field No. 9

Horace Williams (col.), Tenant

Horace Williams' field of 8.21 acres was almost entirely surrounded by timber, which afforded unusually favorable hibernating quarters for the weevil. About half the field consisted of poor soil and the remainder of fairly productive soil. The cultivation given the crop was very indifferent.

On June 8 the squares were removed and calcium arsenate applied. As the plants were small at this time and the stand quite scattering only five pounds to the acre of poison were required. The cost of treatment was as follows:

Labor, picking off squares, 70 hours at $.06	$4.20
Labor, applying poison, 14 hours at $.10	1.40
Calcium arsenate, 41 lbs. at $.10	4.10
Total	$9.70
Cost, an acre	$1.18

The treated field of 8.21 acres produced 3,207 pounds of seed cotton, an average of 391 pounds to the acre, despite the poor soil, poor stand and poor cultivation. This yield is thus compared with the average yield of the two check fields:

Treated	391 lbs. to the acre
Check fields	144 lbs. to the acre
Increase in production, treated field	247 lbs. to the acre

Estimating the value of this increase as in previous experiments, we have:

82.3 lbs. lint at $.21	$17.28
164.7 lbs. seed at $32 a ton	2.63
Total	$19.91

After subtracting the cost of weevil control ($1.18), there remains $18.73 as the acre profit which resulted from the treatment.

INFESTATION RECORDS, PLANTATION EXPERIMENT

Table 7 shows the degree of weevil infestation prevailing in each of the treated and non-treated fields on the Smith plantation from July 1 to August 15.

TABLE 7.—RECORDS OF INFESTATION, PLANTATION TEST

Field	Weevil Infestation, percent			
	July 1	July 15	Aug. 1	Aug. 15
Check No. 1	14.0	70.0	89.9	98.0
Check No. 2	19.0	51.0	79.0	99.0
Treated, No. 1	0.0	11.0	54.9	88.0
Treated, No. 2	0.0	1.6	32.0	76.0
Treated, No. 3	0.2	5.7	34.0	79.0
Treated, No. 4	0.0	1.2	29.0	85.0
Treated, No. 5	0.0	1.0	29.0	79.0
Treated, No. 6	0.0	1.7	50.3	79.0
Treated, No. 7	0.03	0.03	19.0	78.0
Treated, No. 8	0.0	4.6	43.0	84.0
Treated, No. 9	0.0	0.0	34.0	79.0

The figures of Table 7 show that the average infestation upon the several dates in the non-treated fields, on the one hand, and in the treated fields, on the other, was:

	July 1	July 15	Aug. 1	Aug. 15
Check fields	16.5	60.5	84.4	98.5
Treated fields	0.03	3.0	36.1	81.0

The significance of the record in Table 7 is that the treated fields remained, for all practical purposes, free from weevils from the time of treatment early in June until after the middle of July. This was a period of over six weeks during which the plants could set bolls without interference from the weevil. Even when the square infestation reached 36.1 percent on August 1, practically no attack was being made upon the young bolls, as the weevils still had plenty of squares in which to work. As is well known, the setting of bolls does not cease entirely until the percentage of square infestation reaches approximately 100.

The difference in infestation, as the season progressed, between the treated and check fields was fully in keeping with the difference in cotton produced.

Table 8 summarizes the cost of controlling the boll weevil, by the methods heretofore described, in the nine treated fields on the Smith plantation.

TABLE 8.—COST OF BOLL WEEVIL CONTROL, SMITH PLANTATION

Field	Acres	Labor				Poison			Total cost of treatment, to the acre
		Picking off squares		Apply ing poison					
		Total cost	Acre cost	Total cost	Acre cost	Total pounds	Pounds, to the acre	Acre cost	
1	14.93	$7.80	$.52	$3.00	$.20	89.5	6	$.60	$1.32
2	4.81	2.40	.50	.60	.12	24.05	5	.50	1.12
3	22.49	9.60	.43	5.00	.22	157.4	7	.70	1.35
4	5.64	3.36	.59	1.20	.21	45.0	8	.80	1.60
5	4.93	2.40	.49	1.00	.20	25.0	5	.50	1.19
6	3.05	1.92	.63	.80	.26	18.3	6	.60	1.49
7	11.57	6.60	.57	2.50	.21	92.5	8	.80	1.58
8	19.47	9.73	.50	3.89	.20	107.0	5½	.55	1.25
9	8.21	4.20	.51	1.40	.17	41.0	5	.50	1.18
Totals	95.10	$48.01	....	$19.39	....	599.7	....	....	....
Averages	....	....	.53	....	$.20	....	6.2	$.62	$1.34

Table 9 summarizes the increase in cotton production in the Smith fields in which this method of weevil control was applied, the cost of such treatment, the value of the increase in crop at the current prices of $.21 a pound for lint and $32 a ton for seed, and the profit derived from the operation.

TABLE 9.—PRODUCTION AND PROFITS, TREATED COTTON FIELDS, SMITH PLANTATION

Field	Lbs. seed cotton to the acre	Check produced, pounds to the acre	Increase, pounds to the acre	Value of increase, to the acre	Cost of controlling weevil, to the acre	Profit, an acre
1	609	107	502	$40.48	$1.32	$39.16
2	471	144	327	26.37	1.12	25.55
3	339	144	195	15.73	1.35	14.38
4	406	144	262	21.12	1.60	19.52
5	488	144	344	27.73	1.19	26.54
6	454	144	310	24.99	1.49	23.50
7	360	144	216	17.42	1.58	15.84
8	445	198	247	19.91	1.25	18.66
9	391	144	247	19.91	1.18	18.73
Averages	440*	....	294	$23.74	$1.34	$22.43

*By dividing the total production of all 9 fields (41,126 pounds) by the total acreage (95.1) an average of "432" is secured.

From the foregoing table it is seen that the cost of treatment varied from $1.12 to $1.60 an acre. This variation was caused by the difference in size of plants and varying stand in the different fields.

By far the most significant fact of the above results is that Mr. Smith apparently increased the cotton crop on 95.1 acres to the extent of $2257.67[12]. If we deduct from this the cost of controlling the boll weevil on the 95.1 acres, which was $127.37[13], we see that by using this method of weevil control he made a net profit of $2130.30.

RESULTS OF APPLYING CONTROL MEASURES TOO EARLY

While it is very evident that the dual treatment of square-stripping and poisoning cannot give the best results when used prior to the time when practically all weevils are out of hibernation, nevertheless it was deemed desirable to inaugurate experiments to ascertain the actual effect of early treatments.

For this purpose four fields were available on the plantation of C. E. Davis, two miles southwest of Madison. The land was well drained and consisted of Orangeburg sandy loam. Cotton

[12]This figure is arrived at by multiplying the average acre increase in value ($23.74) by the total treated acreage (95.1).

[13]Actual total cost, see Table 8.

had been grown on the plantation the previous year. Excellent hibernating quarters for the boll weevil surrounded the fields.

All fields were planted to mixed seed of upland cotton about March 12. No fertilizer was used. Planting and cultivating were done by negro tenants. The writer supervised the treatments, and Plant Board employees supervised the picking and weighing of the cotton.

One of the four fields was left untreated for a check, while the other three received the weevil control treatment several days earlier than in the experiments already described.

CHECK FIELD

A good stand was secured in the check field of 5.71 acres and it yielded 1,370 pounds of seed cotton, or 239 pounds to the acre.

The percentage of weevil infestation in the check and in the three treated fields, as determined by examinations on July 1, July 15, August 1 and August 15, is shown in Table 10.

TABLE 10.—RECORD OF INFESTATION, DAVIS PLANTATION

Field	July 1	July 15	Aug. 1	Aug. 15
Check	30.0	61.0	76.0	100.0
Treated Fields:				
No. 1	0.01	13.0	80.0	88.0
No. 2	0.5	20.0	69.0	86.0
No. 3	0.05	38.0	76.0	88.0

TREATED FIELDS

Field No. 1

Pomp Johnson (col.), Tenant

A part of this field of 4.52 acres was in cotton last year and a heavy weevil infestation was present this spring. Not over 80 percent of a stand was secured.

On May 18 all squares were removed and calcium arsenate applied at the rate of five pounds to the acre, the cost of treatment being as follows:

Labor, picking off squares, 55 hours at $.06	$3.30
Labor, applying poison, 8 hours at $.10	.80
Calcium arsenate, 22.6 lbs., at $.10	2.26
Total	$6.36
Cost, an acre	$1.41

Between June 1 and 5 a light infestation was found in this field due, apparently, to hibernated weevils. It was quite evident that the treatment had been given too early.

The treated field produced 2,545 pounds of seed cotton, or 563

pounds to the acre. This permits the following comparison with the check field:

Treated	563 lbs. to the acre
Check	239 lbs. to the acre
Increase in production, treated field	324 lbs. to the acre

The value of this increase of 324 pounds is found as follows:

108 lbs. lint at $.21	$22.68
216 lbs. seed at $32 a ton	3.45
Total	$26.13

If the cost of treatment ($1.40) be deducted from the value of the increase, there will remain an apparent profit of $24.73 to the acre. A study of the infestation records indicates that a greater average profit could have been secured had the treatment been deferred for a few days.

Field No. 2

Pomp Johnson (col.), Tenant

This field of 3.67 acres was located about 100 yards from the field described above. Squares were removed on May 18 and calcium arsenate applied the same day at a cost of:

Labor, picking off squares, 20 hours at $.06	$1.20
Labor, applying poison, 7 hours at $.10	.70
Calcium arsenate, 18.35 lbs. at $.10	1.83
Total	$3.73
Cost, an acre	$1.01

As in the former experiment, a light infestation by over-wintered weevils was found in the field a few days after treatment.

The stand in this field was very poor. By actual count the number of cotton plants on the 3.67 acres was no more than sufficient to cover 1.79 acres with a perfect stand. Any comparison of the yields of this field and the check, on the basis of acre production, could not, therefore, show the increase in the crop actually secured by the weevil control operations. However, the comparison of actual yields is:

Treated	321 lbs. to the acre
Check	239 lbs. to the acre
Increase in production, treated field	82 lbs. to the acre

This increase of 82 pounds to the acre, valued at $.21 a pound for lint and $32 a ton for seed, is worth $6.60. After deducting the cost of treatment ($1.01), there remains an apparent profit of $5.59 to the acre.

Field No. 3

Rich Cambric (col.), Tenant

Field No. 3 contained 6.18 acres. The land was decidedly poorer than that in the check field and during the season damage by cotton wilt was very severe.

Treatment to dispose of weevils was applied on May 19 at a cost of:

Labor, picking off squares, 40 hours at $.06	$2.40
Labor, applying poison, 10 hours at $.10	1.00
Calcium arsenate, 30.9 lbs. at $.10	3.09
Total	$6.49
Cost, an acre	$1.08

The weevil infestation in this field appeared early and increased rapidly.

By actual count it was found that there were only 22,190 plants in this field of 6.18 acres, or the number required for a perfect stand on 3.05 acres. As in the case of field No. 2, a comparison of yield with that of the check cannot show the real increase in production due to weevil control. Field No. 3 produced 1,470 pounds of seed cotton, or 245 pounds to the acre. This yield would be compared with that of the check in this way:

Treated	245 lbs. to the acre
Check	238 lbs. to the acre
Increase in production, treated field	7 lbs. to the acre

The value of this difference in production, 7 pounds, if calculated as heretofore, would be $.55. As the cost of treating this field was $1.05 an acre, a "loss" of $.50 to the acre is indicated.

Comparison of the July infestation in these fields and in those which received the weevil control treatment a few days later, shows that hibernated weevils entered these fields after the treatment in sufficient numbers to cause a pronounced infestation of the crop from the start. These treatments, tho too early, did considerable good, for the yield in the treated fields was appreciably larger than it otherwise would have been.

At the same time, the lesson is clear, from this field test, that satisfactory results from this method of weevil control cannot be secured if it is applied before practically all weevils are out of hibernation.

SUMMARY, ALL FIELD EXPERIMENTS, UPLAND COTTON

In Table 11 will be found a summary of the production in all of the fields of upland cotton in which the improved method of control was used. This table includes all fields in which the treatment was supervised by Plant Board employees as well as all those treated by the owners. Of the 20 fields, 18 were in Madison, 1 in Suwanee and 1 in Alachua County.

TABLE 11.—PRODUCTION OF ALL TREATED FIELDS

Treated field	Pounds seed-cotton to the acre	Acre value of crop at $.21 a pound for lint and $32 a ton for seed	Acre cost of weevil control
Sanders, No. 1	356	$28.70	$1.11
Sanders, No. 2	524	42.26	1.30
Sanders, No. 3	516	41.62	1.28
Sanders, No. 4	228	18.39	1.31
Sanders, No. 5	379	30.56	1.72
Hodge	523	42.18	1.01
Wimberly	611	49.27	1.50
Gainesville	550	44.36	6.64*
Smith Plantation:			
No. 1	609	49.13	1.32
No. 2	471	37.99	1.12
No. 3	339	27.35	1.35
No. 4	406	32.74	1.60
No. 5	488	39.35	1.19
No. 6	454	36.62	1.49
No. 7	360	29.04	1.58
No. 8	445	35.89	1.25
No. 9	391	31.53	1.18
Davis:			
No. 1	563	45.41	1.41
No. 2	321	25.89	1.01
No. 3	245**	19.75	1.08
Average	439***	$35.42	$1.57****

*Cotton plants too far advanced at time of treatment, which explains the abnormally high cost.

**Crop severely damaged by wilt, or "black root."

***Total production, all treated fields, divided by their total acreage, gives 432 pounds to the acre.

****The cost of treatment in the case of the Gainesville field really should not be included in arriving at this average. Leaving the Gainesville field out of account, the cost of treatment in the other 19 fields averaged $1.31 to the acre.

The production of all the non-treated fields used as checks is shown in Table 12.

TABLE 12.—PRODUCTION OF ALL CHECK FIELDS

Check Field	Pounds seed cotton, to the acre	Acre value of crop, at $.21 a pound for lint and $32 a ton for seed
Sanders	107	$8.62
Hodge	111	8.95
Plantation		
No. 1	107*	....
No. 2	198	15.97
Davis	239	19.27
Average	164	$13.20

*Same field as Sanders check. Included only once in arriving at average production.

Tables 11 and 12 show that the average crop of short staple cotton in all treated fields was worth $35.42 to the acre, while the average crop of the untreated fields was worth $13.20 to the acre, a difference of $22.22. This difference was brought about solely by controlling the weevil at an average acre cost (in 20 fields) of $1.57.

The fact that this substantial increase in production was secured in all fields—regardless of lack of fertilizer, destruction by wilt, poor cultivation, storm damage, etc.—indicates that the method, properly applied, is dependable.

All other things being equal, the size of the crop depends upon the quality of the land, the variety of cotton, the fertilizer used and the care given. Lacking these things, a large yield cannot be secured, no matter how completely the weevil is controlled. The treatment here described cannot produce cotton; it can only protect it.

The 20 treated fields averaged 439 pounds of seed cotton, while the untreated check fields averaged 164 pounds, an increase of 275 pounds to the acre.

The Florida cotton acreage of 1922 is estimated by statisticians of the United States Department of Agriculture at 122,000 acres. Had the improved method of weevil control been applied to this acreage with results as good as those obtained in our 20 experimental fields, Florida's cotton crop this year would have been increased by 33,550,000 pounds (seed cotton), or 22,366 bales, as well as 11,183 tons of seed.

POISONING EXPERIMENTS IN CAGES

To determine what effect, if any, removal of the squares from the plants would have on increasing the effectiveness of one application of poison, a number of experiments were made from

June to September, inclusive. In these experiments the poison was applied to cotton plants inside of cages. The cages were 4x4x4½ feet in dimensions and were made of 16-mesh galvanized wire cloth securely tacked to a substantial wooden framework.

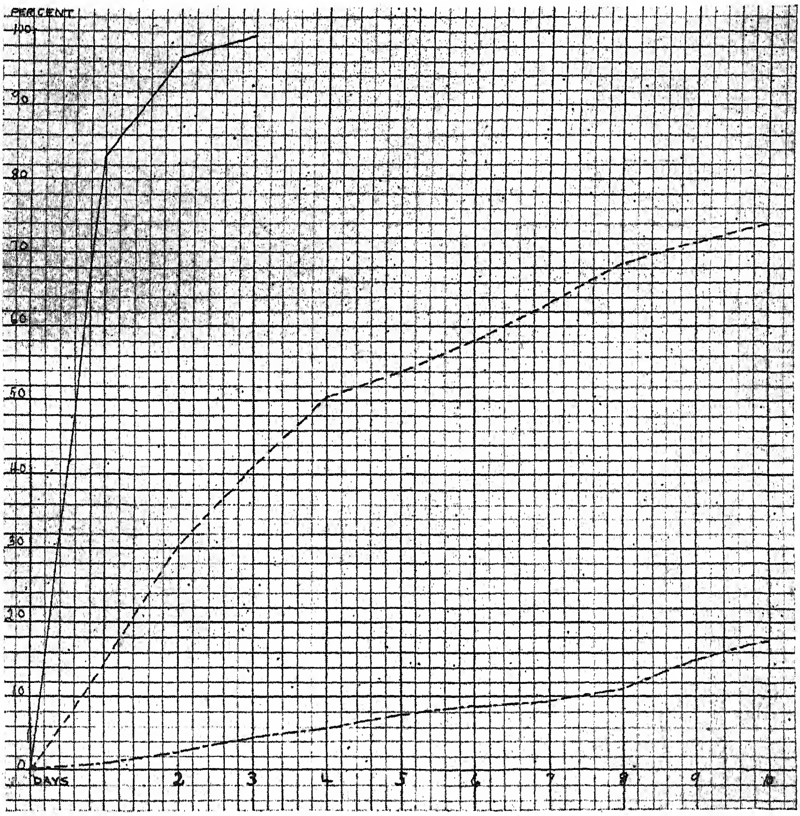

Fig. 9.—Chart showing weevil mortality under certain conditions: (a) all squares removed, followed by application of poison (heavy line); (b) poisoning without removal of squares (dotted line); (c) without either squares removed or poisoning (broken line)

Active adult boll weevils, collected from a nearby cotton field, were placed in the cages on (1) cotton plants from which the squares had been removed and to which an application of calcium arsenate had been made at the rate of about five pounds to the acre, (2) cotton plants from which the squares had not been removed, but to which the poison had been applied at the

same rate, and (3) cotton plants with squares on them, to which no poison had been applied. Examinations were made daily thereafter, when the dead weevils were removed and counted.

A large number of such tests were made, each involving from ten to twenty-five weevils. Table 13 gives their results.

TABLE 13.—DAILY MORTALITY OF BOLL WEEVILS ON (1) POISONED COTTON PLANTS FROM WHICH ALL SQUARES HAD BEEN REMOVED, (2) POISONED COTTON PLANTS HAVING SQUARES ON THEM AND (3) NON-POISONED COTTON PLANTS HAVING SQUARES UPON THEM

24-hour period after application of poison	Poisoned Cotton		CHECK
	228 Weevils All squares removed. Daily mortality, percent	500 Weevils Squares not removed. Daily mortality, percent	(Not poisoned or stripped). Daily mortality, percent
1st	82.01	14.0	1.0
2nd	14.00	16.2	1.5
3rd	3.5	10.8	1.6
4th	....	9.0	1.5
5th	....	4.0	1.2
6th	....	4.0	2.0
7th	....	5.0	5.0
8th	....	5.3	.6
9th	....	3.2	1.2
10th	....	2.7	3.0
Totals	99.59	74.2	17.2

From Table 13 it will be noted that when the poison was applied to cotton plants that had been stripped of their squares, 99½ percent of the boll weevils were killed within three days. On the other hand, when the poison was applied to plants which had squares on them only 41 percent of the weevils were killed within the first three days and, even at the end of ten days, only 74 percent had been killed. The third column shows the much slower rate at which weevils died when they had no poison at all to contend with.

The fact that practically all weevils were killed by the poison within three days, when all squares had been removed, fully explains why, in the field experiments already described, almost total annihilation of the weevils followed a thoro application of

poison just after the squares were stripped from the plants. The data given in the above table are graphically shown in figure 9.

HOW TO USE THE IMPROVED METHOD OF CONTROL

The gist of the method may be summarized in two sentences, as follows:

1. Remove all squares from the cotton plants about June 5 and destroy them.
2. Follow this at once with a thoro application of calcium arsenate or lead arsenate, using a suitable dusting machine.

Simple as this procedure really is, there are many errors which the farmer may make, and if he makes them, he will not satisfactorily control the boll weevil. Therefore, it is necessary that he study the results of the foregoing experiments and thoroly master the points brought out in the following paragraphs.

THE PRINCIPLES INVOLVED

It is useless to attempt to control the weevils by this method until practically all of them are out of their winter quarters. In Florida this is normally about June 5. Treatment earlier than this date will be followed by reinfestation of the fields.

The maximum effect of applying the poison cannot be secured unless the cotton plants are first stripped of ALL squares.

REMOVAL OF SQUARES

It has been found that women and children are just as efficient in gathering the squares as are men. Each worker should be equipped with a tight, well-made cloth sack provided with a draw-string for keeping the mouth closed (see figures 10 and 11). As the squares and weevils are picked from the plants they are placed in the sack and taken from the field and burned, care being taken to see that not a single weevil escapes.

Regardless of whether adults or children are employed, the work should be closely supervised by a thoroly responsible and observant person. It is of the utmost importance that EVERY square be destroyed at this time. With large groups of negroes it has been found advantageous to have individual families work together, the head of the family keeping a close watch over the work of his children as well as working himself. This plan of

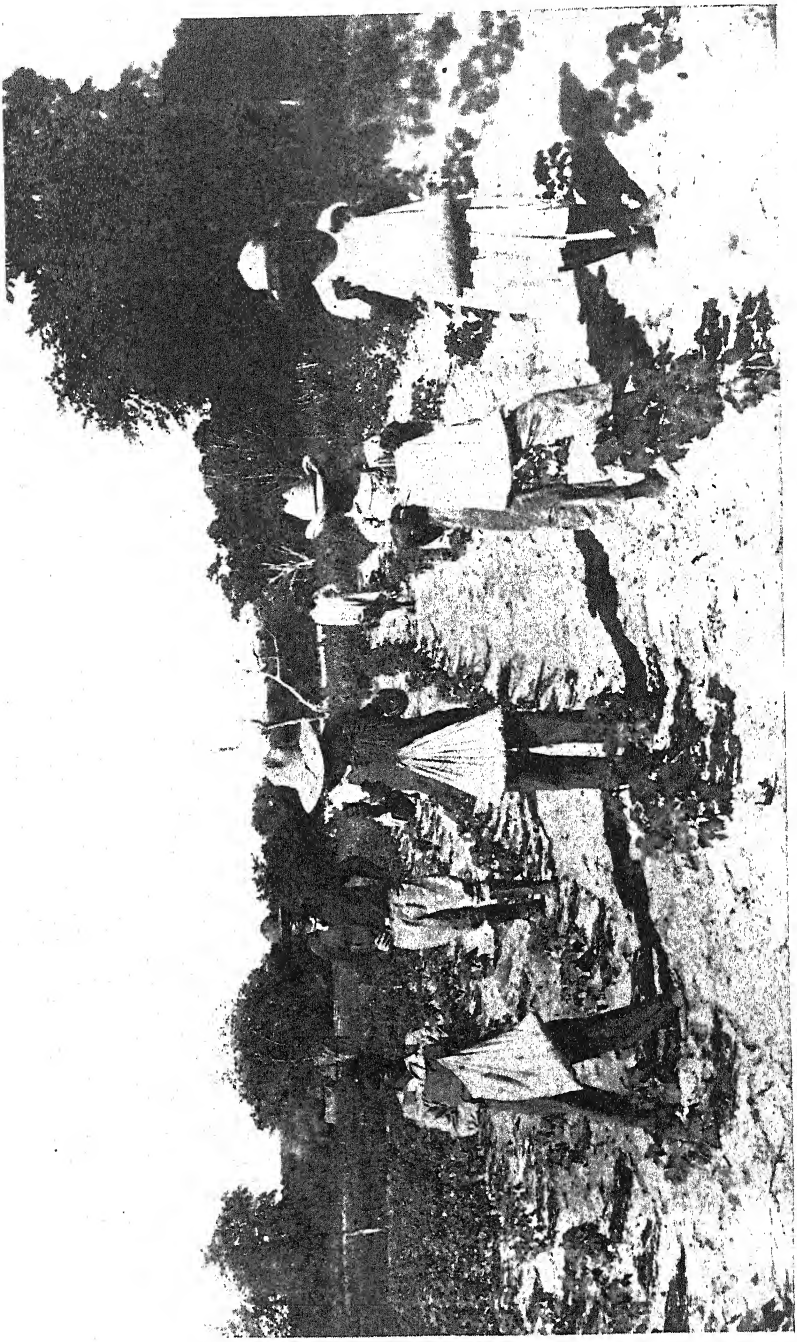

Fig. 10.—Illustrating type of sack used for holding squares as they are removed from the plants. Note draw-strings to keep sacks closed to prevent escape of weevils (original)

grouping the colored people, children particularly, helps to eliminate conversation and careless work.

The square-pickers should commence at one side of the field and take plants and rows as they are reached. As soon as possible after the squares are removed the application of poison should be made. Both operations can be carried on successfully at one time, as shown in figure 12.

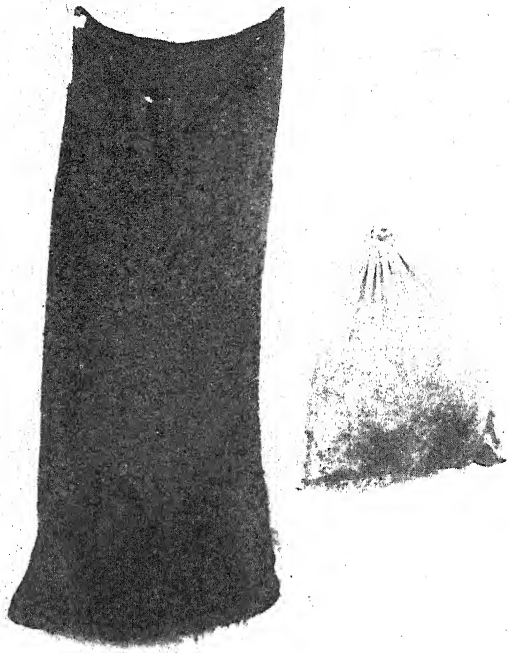

Fig. 11.—Sacks, such as the fertilizer bag shown at the left, are not suitable for collecting squares. For this purpose use bags like that at the right, which is made of strong cloth and closed with a draw-string (original)

POISONS TO USE

There are only two poisons suitable for this work. One is powdered arsenate of lead, the other calcium arsenate. They are about equal in efficiency, so far as killing the weevil is concerned. However, calcium arsenate, as manufactured at present, seems to be in better physical condition for dusting than most of the lead arsenate on the market, and it has the additional advantage of being slightly lower in price, pound for pound. Due to abnormal trade conditions calcium arsenate has, during the season of 1922, been available to the farmer at prices varying from eight to thirteen cents a pound. It is likely, however, that prices during the coming season will be somewhat higher.

Such poisons as paris green and london purple cannot be used. They contain a relatively high content of water-soluble arsenic and will severely injure the cotton plants. Various proprietary

mixtures advertised as "boll weevil poisons" are practically worthless.

Mixing the calcium or lead arsenate with molasses, flour, meal or other material merely decreases its killing power. The farmer will save money and get best results by using nothing except calcium arsenate or powdered lead arsenate manufactured by well-known firms.

It must be remembered that both calcium arsenate and lead arsenate are powerful poisons and must be handled with care. One should use the same precautions as in using paris green. Care should be taken that children do not have access to the poison. For the first ten days or two weeks after the poison is applied work animals used in the cotton fields should be muzzled. After handling or applying the poison, the operator should thoroly wash his face and hands, using plenty of soap.

DUSTING MACHINERY

Success does not follow the application of the poison by sifting it from cloth sacks. Neither will any type of duster give satisfactory results unless it delivers the poison in a steady stream and with considerable force. This can be accomplished only by the type of duster which contains a rotary fan and a device for accurately regulating the rate at which the poison is put out. Unfortunately, most of the hand dusters on the market at present are poorly constructed and will last for only a few days without repair. The Leggett No. 2 duster, made by Leggett & Bro., New York, in spite of its many defects, is the best machine we have found for this purpose.

One duster should be provided for each 10 acres of cotton. However, as the dusters are likely to get out of order, the farmer should provide himself with extra ones (the number depending on his cotton acreage), in order that the poisoning operation may be completed quickly and at the proper time.

Power dusting machinery is not suited to this work and its purchase by the cotton farmer would be a waste of money. In making the one application required by this method of weevil control, it is necessary for the operator to give every cotton plant his personal and careful attention. Every plant must have the poison forced into its terminal bud. No dusting machine has been made which will take the place of intelligence. The best power dusters will miss many plants, particularly where

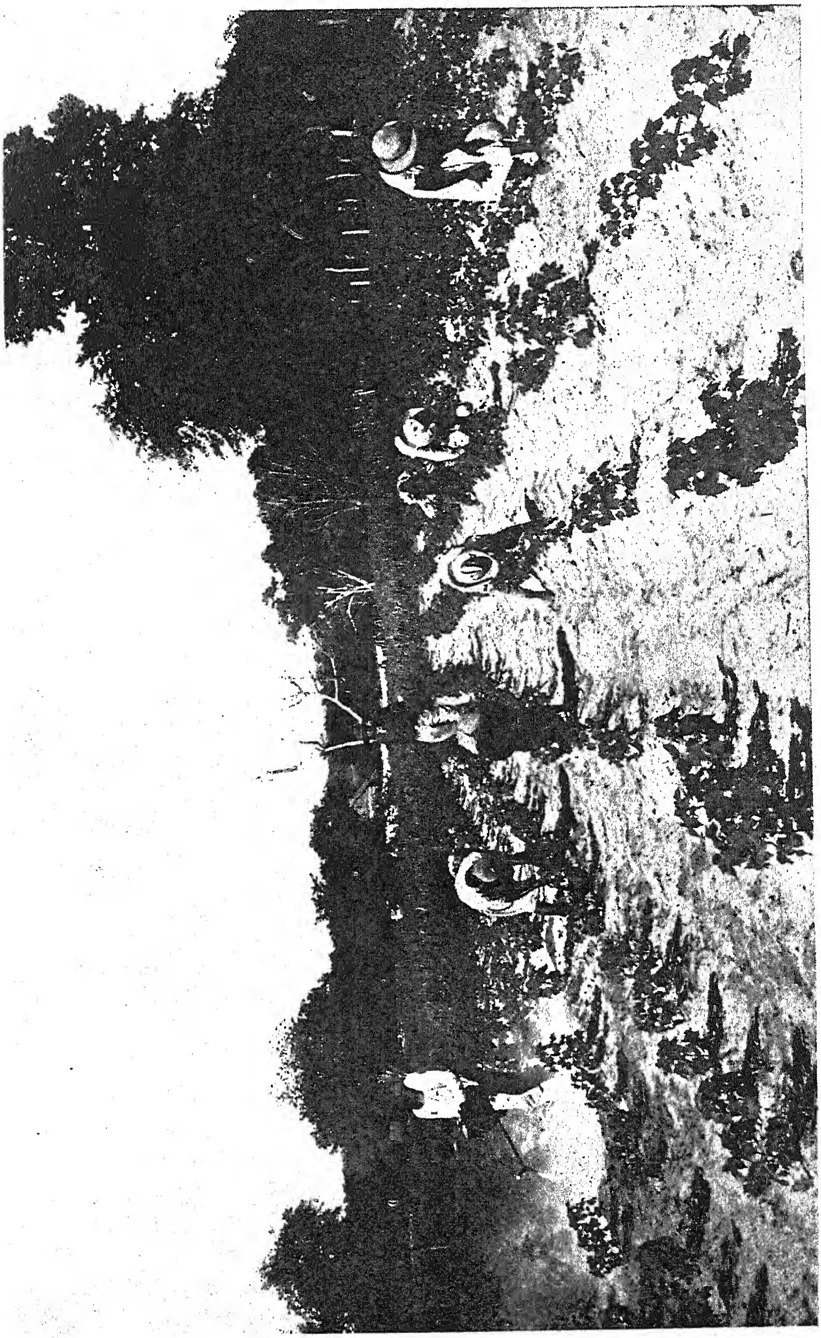

Fig. 12.—Removing the early squares and following immediately with the poison (original)

the rows are not exactly the same distance apart, where the land is uneven, or where there are stumps.

The object is not to scatter poison over the field at random, but to force it actually into the terminal bud of every plant. The poison will not kill the weevil by coming in contact with it.

With the type of hand dusting machine described herein, one laborer can thoroly apply the poison to four or five acres a day.

CARING FOR THE POISON

The supply of poison should be kept always in a dry place and, as far as possible, in air-tight containers.

For taking the poison to the fields ordinary tin lard cans have been found satisfactory (see figure 13). They are not only convenient to handle but protect the poison from rain.

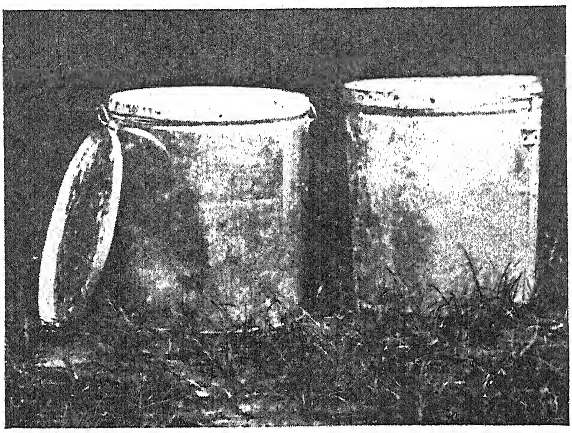

Fig. 13.—Tight tin cans, such as shown here, are excellent for carrying poison to the field and protecting it from moisture (original)

The poison may absorb too much moisture, before reaching the farmer, unless it is put up in proper containers. We strongly urge farmers to purchase only such poison as is shipped and sold in tight containers, lined with waxed or paraffin paper.

APPLYING THE POISON

The farmer should thoroly study the construction of his dusting machines and understand their operation before taking them to the field.

The machine should be set to distribute from five to seven pounds of poison to the acre. The rate can be tested by using, say, a pound of poison on a measured length of row. However, experience soon teaches the operator to tell by the volume of the dust stream about how much he is putting out.

In applying the poison it is of the utmost importance that the operator walk slowly and take pains to force the poison into the small bunch of tender leaves at the tip of the plant.

When rank cotton is reached, as in a low or extra fertile spot, the gauge should be opened slightly so as to deliver more poison, or the operator should work more slowly, so that all plants will be thoroly treated.

As far as possible, applications of poison should be made when there is little or no wind. Early morning and late afternoon are usually the best periods, tho poisoning may be carried on all day if there is little or no breeze. It is often practical to have all hands devote their time to picking squares until mid-afternoon and then apply poison until dark. If the stripped area is not covered by night the poisoning can be continued the following morning.

Applying the poison to plants when they are wet with dew is advantageous, in that the moisture causes the poison to adhere well. Except for this, the presence of dew, or its absence, has nothing whatever to do with the poisoning of the weevil[14]. The insect is poisoned only by eating the tender foliage and buds to which the poison has been applied.

We do not advise applying the poison at night. There is no necessity for it and, besides, the work cannot be done well in the dark.

EFFECT OF RAINS ON THE POISON

In the Florida cotton belt there is always more or less chance of showers early in June. A very light shower, coming after the poison is applied, especially if it falls gently or slowly, is in most cases an advantage in that it serves to stick the poison to the plants.

However, a hard or long-continued rain will wash off the poison. Table 13 shows that, when all squares have been removed from the plants, practically all weevils are killed within three days after the poison is applied. Therefore, if no rain falls for two or three days after the poison is applied, a second application is not necessary. By examination of the plants after a shower one is able to determine whether the application needs to be repeated. As long as plenty of poison remains in the terminal buds, do not worry about the results.

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[14]Newell and Bynum: "Notes on Poisoning the Boll Weevil," Journal of Economic Entomology, Vol. 13, pp. 123-125, Feb., 1920.

AMOUNT OF POISON TO PURCHASE

On account of the possible necessity for repoisoning part of the crop, due to rain, it is well for the cotton grower to secure a supply of poison in excess of what is needed for the one application. We suggest the purchase of about ten pounds of the poison for each acre of cotton. Any that is not used can be kept in good condition until the following season, if stored in tight containers and kept in a dry place.

PROFITS PROPORTIONATE TO CARE OF CROP

It has been clearly pointed out that the largest profit from controlling the boll weevil is invariably secured upon land capable of making a relatively good crop. For the same reason cotton fields which are planted to selected, wilt-resistant varieties, fertilized and cultivated well, yield the largest returns as a result of controlling the boll weevil by this method.

It is far better to plant a small acreage, use plenty of fertilizer and give the best of care, than to plant a large acreage and neglect these essentials.

ANOTHER INSECT PEST THREATENS

The Florida fruit grower is again confronted by the possible introduction of another destructive insect, the camphor scale *(Pseudaonidia duplex* Ckll.), which has found foothold in New Orleans, Louisiana, and at Grand Bay, Alabama. This insect is of Japanese origin and has a large number of hosts, almost one hundred trees and shrubs, including forest and cultivated kinds, having been found to be subject to its attack. Citrus trees and fruits are favorites with this insect, which is much more difficult to control than the scale insects with which Florida fruit growers are familiar. Even before we knew of the advent of the camphor scale, a quarantine inspector of the State Plant Board at Pensacola intercepted a shipment of nursery stock from New Orleans which was infested. This shipment was consigned to one of the largest nurseries in Florida. Associate Entomologist G. B. Merrill identified the scale and reported it to Washington. Every effort is being made to prevent introduction into Florida. It is possible that a Federal quarantine may be imposed. In the meantime, Florida's inspectors are alert.

DEPARTMENT OF CITRUS CANKER ERADICATION

Report on Eradication Work in Cooperation With the Bureau of Plant Industry, for Quarter Ending September 30, 1922

Citrus grove trees inspected	2,708,458
Citrus nursery trees inspected	23,971,389
Inspectors employed	100
Inspectors employed on canker inspection	62
New properties showing active infection	6
Total properties showing active infection	13
Grove trees found infected	85
Nursery trees found infected	0
Counties in which active infections were found	1

General Summary

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	15,105
Nursery trees found infected since May, 1914	342,254
Number properties infected to Sept. 30, 1922	506
Properties declared no longer "danger centers"	482
Properties still classed as "infected" Sept. 30, 1922	24

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to Sept. 30, 1922:

1914		1915		1916		1917		1918		1919		1920		1921		1922	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0	Jan.	0	Jan.	0	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0	Feb.	0	Feb.	0	Feb.	0
		Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1	Mar.	0	Mar.	0	Mar.	0
		Apr.	408	Apr.	49	Apr.	169	Apr.	2	Apr.	1	Apr.	0	Apr.	0	Apr.	0
May	108	May	1042	May	338	May	52	May	1	May	1	May	0	May	0	May	585
June	160	June	772	June	450	June	45	June	10	June	0	June	0	June	0	June	168
July	275	July	651	July	349	July	39	July	0	July	0	July	539	July	0	July	28
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0	Aug.	1	Aug.	1	Aug.	0	Aug.	34
Sept.	767	Sept.	618	Sept.	124	Sept.	6	Sept.	0	Sept.	0	Sept.	0	Sept.	0	Sept.	23
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0	Oct.	0	Oct.	0	Oct.	0		
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0	Nov.	0	Nov.	0	Nov.	0		
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0	Dec.	0	Dec.	0	Dec.	0		
Tot.	4327		6715		2294		372		15		4		540		0		

QUARANTINE DEPARTMENT

Report on Inspections and Interceptions, All Ports and Stations, for the Quarter Ending September 30, 1922

Ships Inspected:		
From foreign ports	444	
From U. S. ports other than Florida	349	
From Florida ports	121	
Total		914
Number of Parcels Inspected:		
Arriving by water:		
Passed	176,685	
Treated and passed	37,630	
Returned to shipper	166	
Contraband destroyed	346	
Total		214,827
Arriving by land, express, freight, wagon, etc.:		
Passed	4,574	
Treated and passed	46½	
Returned to shipper	6	
Contraband destroyed	90½	
Total		4,717
Arriving by mail:		
Passed	182½	
Treated and passed	20½	
Returned to shipper	35	
Contraband destroyed	10	
Total		248
Grand Total of Parcels Inspected		219,792
Number of parcels on hand pending determination as to final disposition	20	
Total Parcels Passed	181,441½	
Total Parcels Treated and Passed	37,697	
Total Parcels Returned to Shipper	207	
Contraband Destroyed	446½	
Grand total		219,792

BEE DISEASE ERADICATION

Report on Inspection and Eradication Work for the Quarter Ending September 30, 1922

Number of apiaries inspected	257
Number of apiaries infected with American Foul Brood	12
Number of colonies inspected	4,208
Number of colonies infected with American Foul Brood	20
Number of apiaries infected with European Foul Brood	1
Number of colonies infected with European Foul Brood	1

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*............*Editor*

ASSOCIATE EDITORS.

E. W. BERGER............*Entomologist*
F. M. O'BYRNE............*Nursery Inspector*
FRANK STIRLING............*General Inspector*
J. H. MONTGOMERY............*Quarantine Inspector*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

THE FLORIDA FARMER AND THE BOLL WEEVIL

Prior to the advent of the boll weevil cotton was the most valuable and dependable crop available to the southern farmer. As a crop it was seldom a total failure. As a source of credit it was unsurpassed. A cash market existed for it at all times. With the coming of the weevil cotton growing became, in many sections, a hazardous occupation, a game of chance with most of the chances against the grower. Profits from cotton culture became so uncertain that the farmer who engaged in it exclusively found himself, as a rule, with neither cash nor credit.

Numerous efforts were made to find other dependable sources of revenue for the cotton grower. In some instances these efforts were successful and there are southern communities that are today even more prosperous than they were in the days when "Cotton was King." The boll weevil has undoubtedly taught the southern farmer the valuable lesson of diversification, but the price paid for it has been, to say the least, exorbitant (the annual reduction in cotton yield ascribed to the boll weevil is now variously estimated at from four to six million bales).

Nevertheless, no crop has been found for the South which possesses the many advantages characteristic of cotton. The fact that in former days the culture of cotton was abused, thru its being grown to the practical exclusion of other crops, does not in the least affect its value as a staple crop.

In North Florida the consequences following the boll weevil invasion were particularly unfortunate. For a time after it was realized that the boll weevil would make cotton growing generally unprofitable, the farmers turned their attention to raising cattle and hogs. During the war and post-war periods, with prices high, the returns were very satisfactory but soon the prices for cattle and hogs fell to the level of, or below, the cost of production. Growing peanuts was a similar experience: at first prices were high, then fell to the point where the farmer could not secure as much for his crop as it had cost him to produce it.

It is frankly admitted that during the last two years the farmer of North Florida has needed a dependable cash crop as never before. This situation has been keenly realized by the officials of the State Plant Board and the University of Florida Agricultural Experiment Station. They, too, have tried to find some crop, adapted to this region, which would take the place of cotton.

Confronted by this situation, the State Plant Board inaugurated an intensive investigation of the boll weevil, believing that the "last word" in control measures had not been reached.

For carrying out its investigations the Board employed, as associate entomologist, George D. Smith, formerly with the Bureau of Entomology, United States Department of Agriculture. His experiments, conducted in three Florida counties during 1922, have given most gratifying results; so gratifying and encouraging, in fact, that it is felt that a new era is at hand for the Florida cotton grower.

For the last 25 years both planters and entomologists have striven to find some sure and certain way of outwitting or controlling the boll weevil. These efforts have not been entirely unproductive; much has been learned regarding the weevil, its habits, hibernation, migrations and seasonal activities.

This information has pointed the way to a number of measures which are more or less contributory to a partial control of the pest but all of them together are not sufficient to insure a profitable crop in a year of normal weevil abundance. The measures referred to include such steps as destroying the cotton plants early in the fall, using early maturing varieties, planting early, cultivating the crop frequently, gathering infested squares

and, in recent years, using the calcium arsenate method of poisoning recommended by the Bureau of Entomology, United States Department of Agriculture.

With the accumulated data of many years at his command and with 13 years' experience in studying the weevil problem, Mr. Smith began his investigations with the State Plant Board. To him must be given the credit of discovering what had been overlooked by all previous investigators, namely, the weak point in the weevil's existence and of perceiving how it could be taken advantage of in making a successful attack upon the insect.

The method of control which he has evolved, while in a way a logical outgrowth of past investigations, nevertheless, is the biggest step toward complete repression of the pest that has ever been made. This happy development is a most striking justification for long continued and persistent scientific investigation of difficult problems.

Altho much has been accomplished, much remains to be done in the way of research and experimentation and it is the purpose of the State Plant Board and the Experiment Station to continue their joint efforts to still further improve the methods of boll weevil control.

Those who have followed closely and critically the experimental work during 1922 and have visited and examined the treated cotton fields from time to time, have come inevitably to the conviction that the relatively simple control method which has been evolved thru Mr. Smith's work now makes it possible for the Florida grower of upland cotton to insure for himself at least 90 percent of a normal crop, so far as weevil damage is concerned.

It has been evident, on poor soils and good, in fields with fertilizer and those without, that the treated fields produced practically as much cotton as if there had been no boll weevils; while untreated fields and check areas—usually only a few hundred feet from the treated fields—produced insufficient cotton to pay for seed and cultivation. How this result has been obtained is explained by Mr. Smith in the pages preceding.

So striking and uniform are the results secured in the 1922 experiments that we would feel remiss in our obligations to the farmers of Florida if we deferred placing this information before them until after the experiments have been repeated another year.

Here, undoubtedly, is information by which any intelligent farmer can materially increase his cotton crop, and the cost of applying it is so low that the method can be profitably used upon the poorest of cotton lands in the state.

The experimental results, therefore, are given to the public in order that they may be made use of during the coming year. No claim is made that a perfect weevil remedy has been developed, but only that a very great advance has been made in the methods of controlling the pest and reducing its damage.

The reader will note in the pages preceding, that Mr. Smith's experiments have been made on typical cotton lands of North Florida, lands consisting largely of Norfolk and Orangeburg sandy loam, rolling and well-drained. On such lands the cotton plant normally shows a very determinate habit of growth and matures its crop relatively early, whether weevils are present or not, a condition somewhat at variance with that which prevails on the alluvial lands of Texas, Louisiana and Mississippi. At the same time, conditions in North Florida are perhaps as favorable to a large winter survival of weevils as anywhere in the South.

While, for the present, the improved method is actually recommended for Florida only, there appears to be no reason, on theoretical grounds at least, why the method cannot be successfully adapted to conditions existing elsewhere in the cotton belt.

While there have been under way investigations to ascertain the value of the improved method of control when applied in connection with sea island cotton, they have not reached the point yet where it is felt that recommendations can be safely made.—W. N.

FLORIDA NURSERY INSPECTION LAW BRIEFLY SUMMARIZED

WHAT IS NURSERY STOCK?

All woody perennials (except Florida forest-grown trees and shrubs), palms and banana plants, or parts thereof intended for propagation, are nursery stock. Before any of these plants are moved from your property to another property (even if you own both properties or give the plants away), the following requirements must be complied with:

1. They must be inspected by an inspector of the State Plant Board. (Sec. 9 of "Plant Act" and Rule 4.)

2. They must have attached a certificate issued by the Plant Board. (Sec. 9 of "Plant Act" and Rule 4.)

3. They must be completely covered in transit. (Rule 4C.)

4. They must be defoliated if it is possible to do so without injuring the plants. All host plants of citrus whitefly must be defoliated. (Rule 4D.)

5. All host plants of San Jose Scale (apple, pear, peach, plum, etc.) must be fumigated with hydrocyanic acid gas immediately before movement. (Rule 4E.)

6. Each movement of stock must be recorded permanently by the nurseryman and also reported to the Nursery Inspector, Gainesville, Florida, by invoice. (Rule 4H.)

7. All host plants of cottony cushion scale, moved from properties in sections where this insect is generally distributed, must be scrubbed in a fish oil soap solution (1 to 5) immediately before leaving the nursery and must be protected from re-infestation after scrubbing. (Rule 4J.)

8. All citrus stock must be scrubbed just before movement in a fish oil soap solution (1 to 5) so thoroughly as to remove all purple, long and chaff scale. (Rule 4K.)

9. Requests for inspection should be made sixty days in advance. (Rule 24.)

10. Citrus grown in scaly bark territory can be shipped only to points in scaly bark territory. (Rule 15.)

The rules mentioned in parenthesis are the rules of the State Plant Board, which cover the points immediately preceding. No charge is made for the inspection of nursery stock. Certificate tags (See 2 above) are supplied at actual cost.

This is merely a brief resume. A complete set of the law, rules and regulations will be sent to any one upon request. Requests for copies of the rules or for inspection should be made to the Nursery Inspector, Gainesville, Florida.—F. M. O'B.

SWEET POTATO PLANT INSPECTION

Florida plant growers have for a long time been shipping into other Southern States large quantities of early sweet potato plants each spring. This business is one which has grown considerably in recent years as the sweet potato crop is, next to cotton, corn and hogs, the big money crop of the South. The sweet potato is susceptible to a number of diseases and insect pests which are present in different sections. In order to prevent

the distribution of these pests, the authorities of the different states have imposed certain requirements regarding shipment of sweet potato plants into these states. For instance, South Carolina, Mississippi and Arkansas issue to shippers permits for shipment only after being supplied with certain definite information based upon inspections made by competent officials of state of production of (a) fields in which seed potatoes were grown, (b) seed potatoes before bedding and (c) of plant beds. There is also a requirement that seed potatoes be disinfected before bedding and the plants be grown under supervision.

The Florida Plant Board will place at the disposal of plant growers the services of its inspectors for making the necessary inspections. Plant growers should communicate with the Plant Commissioner, Dr. Wilmon Newell, Gainesville, Florida, for further information or advice.

A USEFUL BULLETIN[15]

The avocado, like practically every other plant, especially when grown commercially or on a large scale, is certain to become infested with injurious insects. These interfere with the perfect development of the trees and fruit and not infrequently result in considerable financial loss to the owners. Sometimes the injury may be so severe as to result in a total loss of crop or trees, or both.

Mr. Moznette's bulletin of thirty-one pages, illustrated by twenty-two figures (three of them full page size) consists of interesting reading as well as very practical information for the avocado grower. It is believed that everyone interested or engaged in avocado growing will find a copy of this bulletin very useful and should keep it properly filed for reference.

This bulletin, furthermore, treats of the nine principal insects infesting the avocado in Florida. It gives a brief account of the life-history of each one, together with practical directions for its control.

The bulletin also warns against the introduction into Florida of three very injurious insects known to infest the fruit of the avocado in certain foreign countries.—E. W. B.

[15]The Avocado: Its Insect Enemies and How to Combat Them. By G. F. Moznette, Assistant Entomologist, Bureau of Entomology, U. S. Department of Agriculture, Miami, Fla. Copies of this bulletin (Farmers' Bulletin 1261) may be obtained free by addressing Division of Publications, U. S. D. A., Washington, D. C.

THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. VII January, 1923 No. 2

LETTER OF TRANSMITTAL

January 8, 1923.

To His Excellency,
Cary A. Hardee,
Governor of Florida.

SIR: Herewith is submitted the report of the State Plant Board of Florida for the period beginning May 1, 1920 and ending June 30, 1922. Please submit same to the Legislature.

Respectfully,
STATE PLANT BOARD OF FLORIDA,
By P. K. YONGE,
Chairman.

REPORT OF STATE PLANT BOARD

The activities of the State Plant Board have continued throughout the period covered by this report along the lines contemplated in the Florida Plant Act of 1915 (Chapter 6885, Laws of Florida) under which the Board functions. The report of the Plant Commissioner, Wilmon Newell, which is made a part of this report, recounts with more or less detail the field and scientific work which has been prosecuted under the Board's direction to prevent the introduction into and the spread within the State of plant pests and to eradicate or control several such pests of major importance. This work has been done, in the opinion of the Board, in a satisfactory and economical manner and the results have been beneficial to the agricultural interests of the commonwealth.

The financial report showing sources of income and nature of expenditures is also embodied in this report.

The personnel of the Board is as follows: P. K. Yonge, E. L. Wartmann, J. B. Sutton, W. L. Weaver and John C. Cooper, Jr. Messrs. Sutton and Wartmann had been appointed as members during the preceding biennium. Messrs. Yonge, Weaver and Cooper were commissioned as Board members by Governor Hardee July 8, 9 and 19, 1921, respectively. The present Board or-

ganized July 11, 1921, by electing P. K. Yonge as Chairman and J. T. Diamond as Secretary.

The reports of the Plant Commissioner and Secretary are transmitted herewith.

STATE PLANT BOARD,
P. K. YONGE,
Chairman.

REPORT OF THE PLANT COMMISSIONER

For the Period from May 1, 1920 to June 30, 1922

Gainesville, Florida, November 24, 1922.

Honorable P. K. Yonge, Chairman,
State Plant Board of Florida.

SIR: I have the honor to present herewith report covering the activities of the State Plant Board as conducted through the Plant Commissioner's Office for the period May 1, 1920 to June 30, 1922.

It will be noted that the time reported on differs from that of previous reports of a similar nature in that formerly the period extended from May 1 to April 30, a biennium. It has been thought best to submit the present report for the period to come up to June 30, 1922, inasmuch as that is the end of the State's fiscal year. This report, therefore, is for twenty-six months. This will make it possible to submit future reports for two year periods terminating June 30. Thus the reports of the State Plant Board will conform with respect to the periods reported on to those of other State governmental bodies.

Respectfully,
WILMON NEWELL,
Plant Commissioner.

The work of the State Plant Board has been conducted through the several departments very much along the same lines as indicated in previous reports. Grove inspection and citrus canker eradication have continued to be the chief activity of the Board and its operating force just as has been the case since the creation of the Board through the Plant Act of 1915. However, the relation of the Nursery Inspection and Quarantine Inspection Departments to this special line of work has been so intimate that it is difficult to draw a distinct line of demarcation. In fact, all lines of Plant Board work are very closely linked. It is a pleasure to report that the various departments have functioned smoothly, both in their special lines of work and in their joint efforts.

Material reductions in the sums available for prosecution of grove inspection (citrus canker eradication) have necessitated

marked curtailment in the number of men engaged in this work with corresponding decline in efficiency to the extent that much less inspection work could be done. The efficiency of the actual inspection has likewise suffered, for the reason that with shortage of men and the necessity for covering a given acreage of trees within the period being reported on, the inspectors have been somewhat "speeded up." This "speeding up," however, is not applied to the areas regarded as especially dangerous, that is, localities where canker had formerly been found. No new infections and no recurrences of infection have been found during the twenty-six months, except for the outbreak at Boynton in June of 1920 and that at Davie in May of 1922, both of which are reported on further in this report. Other lines of work have not suffered from the same handicap. The Nursery Inspection and Quarantine Inspection Departments have been able to maintain, and in some respects, improve on the high standard of service heretofore rendered.

NURSERY INSPECTION

Through the Nursery Inspection Department, distribution of plant pests within the State has been largely prevented, and horticulturists have been assured that plant stocks (trees, shrubs, etc.) are free from especially injurious pests, and when planted do not suffer from the handicap of being affected by some disease or insect pest.

On the whole, the nurserymen have cheerfully and willingly complied with the Board's requirements respecting the inspection and certification of nursery stock. The nursery business in Florida is highly developed and is carried on on a huge scale. This is particularly so with regard to citrus. There have been inspected during the fourteen months ending June 30, 1922, 3057 nurseries in the State. Many of these are small, while others are of very large size. The Board does not distinguish between these classes nor restrict its inspections to nurseries which are generally regarded as "commercial," but extends inspection facilities to the smaller operators. In other words, all nursery stock which may be distributed is inspected. The acreage in the 3057 nurseries totaled 3,815.33 acres distributed as follows:

Citrus	2,708.45
Pecans	283.12
Strawberry	247.35
Avocados	16.37
Peach	10.12
Ornamental and General	549.92

On June 30, 1922, 1085 nurseries in the State were holding certificates from the State Plant Board. These are listed as follows according to kind of stock:

Number of Certified Nurseries in the State of Florida as of June 30, 1922

Nurseries listed relative to variety of stock

Citrus	723
Fig	1
General	136
Stock Dealers	25
Ornamental	115
Non-citrus	14
Pecan	17
Blackberry	10
Banana	13
Cocoanut	6
Huckleberry	1
Raspberry	1
Grape	10
Avocado	8
Guava	3
Mango	2
Total	1,085

Several nursery operators were guilty of violations of the Plant Act or of the rules of the Board. On a number of occasions the Board has felt that the interests of the public would be protected by administering a caution or a reprimand to the offenders. In some instances, however, the offense seemed to be so flagrant or there were repeated infractions, so that the Board instructed prosecutions. Twenty-three complaints were filed. In nineteen of these, penalties were imposed by the courts. One case resulted in acquittal and three cases were dropped.

On May 1, 1920, four cases in which information had previously been filed had not been disposed of. The same number remain in the hands of the courts at the end of the present report period.

As in former years, the nursery inspection work has been conducted through the medium of Assistant Nursery Inspectors situated in various parts of the State and operating under the direction of the Nursery Inspector, Mr. F. M. O'Byrne, who has had charge of this work since the organization of the Board.

There are eleven Assistant Nursery Inspectors in as many inspection districts. It has been our aim to make four inspections annually. This has not been possible in all cases.

QUARANTINE DEPARTMENT

The Quarantine Department through its inspectors is preventing the ingress of infected or infested plants from other states and countries. Not only are the activities of this service directed to preventing entry of diseased or insect-infested plants, but the effort is made to prevent entry of pests by any means, such as, for instance, by affected fruits or vegetables or of parts of plants which might serve as carriers, and naturally there is a concentration of effort directed against the entry of pests of a more serious nature which have not as yet gained a foothold in Florida. This applies to dangerous material from other states as well as from foreign countries.

Inspection stations are located at the principal ports of entry, namely, Pensacola, Jacksonville, West Palm Beach, Miami, Key West and Tampa. Nine men are engaged in this work. All material which comes into the State from foreign countries and to which the rules of the State Plant Board or of the Federal Horticultural Board apply, is passed upon by these inspectors. Such material as is excluded by the rules is prevented entry. Other material which may come in under restrictions is handled accordingly. All fruits and vegetables from certain countries where blackfly exists are inspected or fumigated or both. The inspection is for the purpose of discovering whether or not dangerous material such as leaves, twigs, etc. is included. If intended for delivery in Florida, the shipments are fumigated as well as inspected. In the course of their work, the inspectors are also required to see that shipments of nursery stock from other states into Florida are made in conformity with the safeguards prescribed by the Board.

All foreign vessels arriving at Florida ports are boarded and searched in company with the customs officials in the effort to discover contraband or dangerous horticultural materials.

During the year ending April 30, 1921, 3035 vessels from foreign ports and 1949 vessels from domestic ports were boarded; 701,783 packages were inspected, 42,565 fumigated, and 3136 contraband returned or destroyed.

For the fourteen months ending June 30, 1922, 2583 foreign vessels and 2288 domestic vessels were boarded; 2,084,498 pack-

ages were inspected, 93,507 packages fumigated, and 4296 packages of contraband were returned or destroyed.

For the full period covered by this report (twenty-six months) 209 different plant pests from 42 foreign countries were intercepted. On 15 occasions blackfly infestation was discovered on horticultural material. Fourteen interceptions were made of West Indian fruit fly.

DEPARTMENT OF ENTOMOLOGY

The Entomological Department has continued to function along the lines originally planned. Specimens submitted by inspectors of the several field services are examined and identified. Many thousands of such are received and handled each year. Frequently the decision as to quarantine of nurseries or the disposition of nursery stock intercepted by quarantine inspectors is determined by the report from the Entomologist.

The production of pure cultures of whitefly fungus has continued, and this material has been distributed to growers for counteracting the whitefly. A natural insect enemy of the cottony cushion-scale, the Vedalia, or Australian lady beetle, has been collected in quantities by field agents and distributed through the Entomological Department for liberation in areas where cottony cushion-scale was present. A certain quantity of Vedalia has also been reared by the Entomologist. The Entomologist and Associate Entomologist have also on many occasions identified insects sent to the laboratory by growers and have advised as to control measures to be made use of. Under direction of the Board, special investigations have been made with respect to insects affecting cotton.*

The Plant Board has not had in its employ a Plant Pathologist. The Pathologist of the Florida Experiment Station has been available in connection with matters pertaining to plant diseases and the Station has generously permitted us to call for such help when necessary. This generosity has been appreciated and the privilege has not been abused.

*Subsequent to the period covered by this report, announcement was made by the State Plant Board of the successful outcome of the preliminary investigations made under direction of the Board. This announcement made public the development of a method of control of the boll weevil which in extensive field tests showed its efficiency under Florida conditions. The method is simple, inexpensive and practical. It is believed that as the result of the investigations of the Plant Board's specialists there will be a return of profitable cotton growing in Florida. The work done on this project by Associate Entomologist G. D. Smith, the method developed and the results obtained are fully described in the October, 1922, issue of the Quarterly Bulletin of the State Plant Board and in Bulletin 165 of the Florida Agricultural Experiment Station.

Sweet Potato Weevil Eradication

The efforts of the Board to prevent the spread of the sweet potato weevil have not relaxed. This insect appears to be established along the coast line of the peninsula from a point north of Daytona on the east coast to the north line of Pasco County on the west coast. The quarantine regulations of the Board covering the movement of sweet potato tubers, plants, and vines from the infested areas have been applied as thoroughly under the circumstances as conditions would permit, and seemingly with success, for repeated and frequent inspections by both State and Federal employees have not shown any marked spread. In Baker County, where a campaign to eradicate this pest of sweet potatoes has been in progress for the past several years, very marked progress has been made. Of the 220 farms which have all told been found to be infested in the affected area of Baker County, only 42 are now classified as being actively infested.

Mosaic Disease of Sugar Cane

The last biennial report contained rather detailed information with respect to the discovery of the mosaic disease of sugar cane in Florida and what steps had been taken to eradicate as well as to prevent the spread of the disease from the infected areas. These efforts have been continued by the agents of the Board. The situation in West Florida was found to be very much more serious than had been anticipated, the disease having been spread by various means into many of the fields and into many of the cane plantings throughout West Florida. Investigations conducted by the Plant Board have shown that the mosaic disease is fairly generally distributed in all of the counties of North and West Florida as far east as the eastern boundary line of Jefferson and Madison Counties. All of this area, under the rules of the Board, has been placed under quarantine. The quarantine is of such a nature, however, as not to restrict movement of sugar cane within the area described. Shipments to points outside of the quarantined area are not, however, permitted.

In the peninsular section of the State, where a number of isolated infected cane fields had been discovered, and where eradication work had been undertaken, the situation was such as to permit of a successful campaign being waged. All of the cane in the infected fields was destroyed with the cooperation of the owners and quarantines imposed. No recurrence of the disease

has been discovered, either on the farms where the infected fields were located, or in any other part of the peninsular section. We are much gratified at this most excellent result.

The Board, feeling that eradication of the mosaic disease was impossible in West Florida, and believing that sooner or later all sugar cane in that section would be seriously interfered with by reason of the disease, has undertaken a project which, it is hoped, will materially assist the cane growers. It is known that certain varieties of sugar cane are immune, or at least very highly resistant to the mosaic disease. Among these varieties, and perhaps the best, so far as sugar content and production are concerned, is that known as Cayana 10. This is a very greatly improved type of the Japanese or East Indian variety of sugar cane. The Board has been enabled to secure a rather limited quantity of seed cane of this variety and has made a planting of it at Gainesville. From this small planting, a larger planting will be made, and the Board will be in position to distribute in the spring of 1924, small quantities of seed cane of this immune variety to individual farmers in the localities where the mosaic disease appears to be doing the greatest damage. It is contemplated that by this means, gradually the immune or resistant variety will replace on the farms the varieties which are susceptible to the disease.

Bee Disease Eradication

The Bee Disease Act of 1919, Chapter 7938, Laws of Florida, imposed upon the Plant Board the duty of eradicating infectious diseases of honey bees when found inside the State, and preventing the spread within and introduction into the State of such diseases. Mr. C. A. Reese was employed as Assistant to the Plant Commissioner in Bee Disease Eradication on March 1, 1920, and was in charge of field work under the Plant Commissioner's direction until July 1, 1921, when Mr. J. C. Goodwin was appointed by the Board as Apiary Inspector. Under Mr. Reese, and later Mr. Goodwin, inspection work was continued along the lines previously inaugurated. Local or District Inspectors (experienced, practical beekeepers) were engaged by the Board and reimbursed for the time when actually employed upon a per diem basis. These local inspectors, with Messrs. Reese and Goodwin, have prosecuted the bee disease eradication campaign vigorously. Inspections have been made of apiaries in various

sections of the state for the purpose of detecting any infection of honey bees which might be present.

Inspectors have been especially interested in the discovery of American foul brood, which is regarded as the most serious condition affecting honey bees. When a diseased condition has been found, treatment has been instituted, or, as in the case of American foul brood, the infected colonies have been destroyed. During the twenty-six months ending June 30, 1353 apiary inspections were made, these representing 34,602 colonies. In 39 apiaries American foul brood has been found and 69 colonies have been destroyed. This disease has been discovered in 6 counties. It is believed that the disease has been eradicated in all areas except in several apiaries in Pinellas and Palm Beach Counties. In West Florida where in certain sections, particularly along the Apalachicola River, the industry is highly developed on a commercial scale, and where considerable foul brood had been found prior to 1921, no infections have been found, although the apiaries in the area have been under close and constant observation. The inspection of the whole state has not been completed, work only having been undertaken in such areas as were suspected of having American foul brood.

Under the rules of the Board, made for the protection of the bee industry, certain quarantines are imposed on infected apiaries and areas in order to prevent distribution of disease. These quarantines, with few exceptions, have been observed and the beekeepers have, with one or two exceptions, cooperated with the employees of the Board in their efforts. It is a well recognized principle of pest control that prevention is almost as important as control or eradication. Consequently, the Board passed rules regulating the shipment of bees and used bee equipment into the State. The Quarantine Inspection Service has rendered great help in applying these rules, and on several occasions has been instrumental in preventing the shipment into the State of honey bees which were regarded as being possible carriers of disease.

Rules

To meet new situations or changed conditions, new rules of the Board have been adopted from time to time or existing rules have been amended. Authority for this is given under the Plant Act of 1915. Previous reports have contained a synopsis of the rules of the Board up to and including Rules 45A and 45B. The

following rules have been adopted or amended during the period covered by this report.

Rules and Public Notices

1920

August

(1) Public notice declaring certain areas to be infested with the sweet potato weevil, adopted.
(2) Public notice declaring certain additional areas to be infected with scaly bark, adopted.
(3) Provisions of Rules 45A and 45B, with respect to the interstate movement of cotton, were suspended and Federal Horticultural Board regulations applied instead.

September

(1) Rule 36 amended.
(Disinfection, etc. in public packing houses)
(2) Rule 40F amended.
(Movement of honeybees into the two-mile zone surrounding a center of infection by bee disease, prohibited.)
(3) Rule 46 adopted.
(Prohibiting importation into Florida of hosts of West Indian fruit fly)

October

(1) Public notice with regard to scaly bark adopted, in lieu of all previous public notices on same subject.
(2) Rule 46 repealed.
(Prohibiting importation into Florida of hosts of West Indian fruit fly)
(3) Rule 11E adopted.
(Prohibiting importation into Florida of fruit of guava, Surinam cherry, Cuban plum and mango, on account of danger of introducing West Indian fruit fly)
(4) Counties of Polk and Orange eliminated from public notice in regard to mosaic disease, adopted 10-13-19.

November

(1) Public notice adopted, declaring yam weevil to be a public nuisance.
(2) Public notice declaring certain areas within State of Florida to be infested with sweet potato weevil amended so as to include additional territory.
(3) Public notice (adopted October 13, 1919) amended by striking out Counties of Manatee and DeSoto from area infected by mosaic disease.
(4) Rule 44 amended.
(Prohibiting importation of certain material from areas infested by Japanese beetle)

December

(1) Rule 4D amended.
(In regard to defoliation of nursery stock before movement)
(2) Public notice (adopted October 13, 1919) amended by striking out certain territory from area designated as infected by mosaic disease.

1921

February

Rule 4D amended.
(In regard to defoliation of nursery stock before movement)

March

Rule 4D amended.
(In regard to defoliation of nursery stock before movement)

April

Public notice (adopted 9-13-17) with regard to areas infested by sweet potato weevil, amended.

May

Rule 42A amended.
(Concerning movement of sugar cane out of mosaic infected areas)

June

(1) Public notice (adopted 3-12-17) with reference to areas infected by scaly bark, amended.
(2) Public notice re Mexican bean beetle and Japanese camphor scale, adopted.
(3) All rules not in conformity with the decision of the Supreme Court in the Wolyn case were amended.

September

(1) Rule 15 amended.
(Regulating movement of nursery stock grown in scaly bark areas)
(2) Public notice (adopted 9-13-17) declaring certain areas in Florida to be infested with sweet potato weevil—amended.

October

Rule 4L adopted.
(Providing for recall of nursery certificates upon failure of holder to comply with rules of Board concerning same, etc.)

November

(1) Public notice (adopted 10-13-19) amended.
(Declaring certain areas in Florida to be infected with mosaic disease)
(2) Public notice (adopted 10-11-20) amended.
(Declaring certain areas in Florida to be infected with scaly bark)

December

(1) Public notice (adopted 10-13-19) amended.
(Declaring certain areas in Florida to be infected with mosaic disease)
(2) Rule 11A amended.
(Prohibiting shipment into Florida of all citrus fruits from the Gulf States)
(3) Rule 11B amended.
(Prohibiting shipment into Florida of all citrus fruits from California)
(4) Rule 46 adopted.
(Sale, gift, exchange, movement, etc. of trees or plants brought into state in violation of law, prohibited)

1922

February

(1) Public notice (adopted 10-13-19) rescinded.
(Declaring certain areas in Florida to be infected with the mosaic disease of sugar cane.)
(2) Rules 42A, 42B and 42C rescinded.
(Regarding mosaic disease of sugar cane)
(3) Rule 47A adopted.
(Prohibiting movement of sugar cane out of mosaic infected areas into other parts of state)
(4) Rule 47B adopted.
(Requiring destruction of all mosaic infected plants)
(5) Rule 47C adopted.
(Declaring every mosaic infected field, garden, yard or plant the center of an infected and dangerous zone; prohibiting planting of cane or other host plants in such properties, etc.)
(6) Rule 47D adopted.
(Prohibiting the replanting of mosaic infected properties to sugar cane or other hosts of mosaic disease for one year after destruction of infected plants)

(7) Public notice adopted.
(Declaring certain areas in Florida to be infected with mosaic disease of sugar cane.)

March

Rule 47C suspended.
(Declaring every mosaic infected field, garden, yard, or plant the center of an infected and dangerous zone; prohibiting planting of cane or other host plants in such properties, etc.)

April

(1) Rule 4G amended.
(Providing for certain exceptions to the rule requiring certification of nursery stock)

(2) Rule 4M adopted.
(Shipment of strawberry plants into State of Florida prohibited except under certain conditions)

May

(1) Rule 6 amended.
(Providing for issuance of certificates of inspection and defining the forms of certificates to be used)

(2) Rule 4A amended.
(Declaring certain insects, pests, etc. to be especially injurious, etc.)

It was also found necessary to amend a number of the rules of the Board in order to conform to a decision of the Supreme Court of Florida. This decision was in a case filed by A. H. Wolyn of Mary Esther, Florida, in which Mr. Wolyn appealed to have the rules of the Board regarding shipment of sugar cane from quarantined areas declared null and void. The Supreme Court, in its decision, declared the opinion that in the case of the Board rules which were sought to be set aside, the Board had exceeded its authority under the Plant Act in delegating to the Plant Commissioner certain powers with respect to lifting quarantines or the time of lifting such quarantines, which powers could only be exercised by the Board itself. The effect of this decision was that a number of the rules of the Board had to be amended in order to conform to the decision of the Supreme Court. These amendments were made at the meeting of the Board held at Gainesville, Florida, on June 6, 1921.

Cooperation

The closest and most cordial cooperative relations with other agricultural and horticultural organizations have existed. Such organizations have extended to the Plant Board invaluable help. The Federal Department of Agriculture through its Bureau of Plant Industry has continued to aid in the eradication of citrus canker, and the same Bureau has assisted in the mosaic disease campaign.

Through the Bureau of Entomology, the Department of Agriculture has very materially contributed to the success of our efforts to control the spread of the sweet potato weevil and to eradicate this insect from the isolated area in Baker County, where it had become established.

The Federal Horticultural Board has continued the appointments of Assistant Quarantine Inspectors of the State Plant Board as Collaborators of the Federal Board, thus giving authority to the State Inspectors to apply the Federal plant quarantine rules. The State, however, bears the salary and other expenses involved.

The Agricultural Experiment Station of the University of Florida has never failed to lend the support of its experts, and the Agricultural Extension Division has, on many occasions, supplemented the Plant Board's activities.

Members of the Plant Board staff have been present at, and participated in numerous meetings of horticulturists and agriculturists in all sections of the State. Members of the staff have also taken part in a limited way as special lecturers and instructors in the educational work conducted by the College of Agriculture and Agricultural Experiment Station.

In the preceding, an attempt has been made to briefly outline the activities of the Board. More detailed and statistical information as to the special activities of the several departments of the Board operating under the Plant Commissioner may be found under the sections of this report devoted to these particular departments.

During the period covered by this report, economy in expenditures has been practiced. During the fiscal year of 1920-21, all funds available were utilized to the greatest advantage, and the year was ended with complete equipment and a large stock of supplies on hand. Only three cents of the general appropriation for the year ending April 30, 1921 was returned to the Treasurer.

It has always been the policy of the Board since its creation to, as far as circumstances and demands would permit, conserve its funds and limit its expenditures in such a manner as to have available a reserve fund for use in emergencies. This policy was followed during the year ending April 30, 1922. No situation developed during this period of sufficient magnitude to call for the expenditure of the reserve thus created, with the result that

there reverted to the State Treasury, May 1, the sum of $16,775.12. It must be admitted that there may be some question as to the wisdom of this policy, for the reserve which reverted as unexpended balance was built up at the sacrifice of efficiency in several of the departments. This sum could have, without question, been expended very advantageously in extending and strengthening any one or all of the departmental activities which had been correspondingly curtailed or weakened in the effort to build up the reserve. This experience serves in a way, however, to indicate the necessity for the provision by the legislature of a reserve fund for use in such emergencies as might arise, and thus make available for current and actually necessary routine expenses of operation, all of the funds appropriated for that purpose. Such a fund should, in our judgment, be of a size to meet serious situations which might arise, such as an extensive recurrence of citrus canker, or the discovery of the introduction and establishment of pests of first magnitude. The successful handling of such situations depends upon the promptness and vigor of the repressive measures undertaken. As a matter of fact, just such a serious situation materialized only a short while after the unexpended balance in the general fund had reverted to the Treasury. This was the discovery of canker infection at Davie, which called for a concentration of all of the Board's available inspectors at this point, and the expenditure of large sums of money in the attempt to immediately handle the situation.

CITRUS CANKER ERADICATION DEPARTMENT

Throughout the twenty-six months included in this report, the work of eradicating citrus canker has continued to be the main endeavor of the Board. All properties and areas in which infection has ever been found have been kept under close observation and inspections have been made of citrus plantings throughout the State. It is gratifying to report that during the twenty-six months infections have been discovered in only two localities in the State.

In July, 1920, a large number of infected trees were found at a point about three miles west of Boynton in Palm Beach County. This situation developed undoubtedly as a result of infrequent inspections due to shortage of inspectors. In all five properties were found to be infected and 540 trees in these properties were diseased. By vigorous and prompt measures, including the de-

struction of all trees in the infected properties (except one grove, that of Charles Stitts, located in the town of Boynton) this infection was suppressed. There has been no recurrence. Careful inspections made at the time of the discovery of the infection as well as since, have failed to disclose any additional infected trees.

An almost similar situation was discovered in May of 1922 at Davie, an isolated settlement about ten miles southwest of Fort Lauderdale in Broward County. This settlement is on reclaimed Everglade land, and there are no important citrus plantings located within a distance of some three miles of Davie. This is a fortunate circumstance, for undoubtedly the disease has been confined, so far as our investigations have disclosed, to the affected area at Davie itself. In 1915, a few infected trees had been found and destroyed in this settlement, and the disease apparently stamped out. Repeated inspections subsequent to 1915 and up until 1922 failed to show any return of the disease. In May of 1922, however, 216 trees were found in a grove at Davie, and further search has resulted in locating 14 properties in which were 753 infected trees.

Fortunately there has been no spread from these two isolated areas. At least careful inspection all along the lower east coast section and the following up of all possible means of transmission of the disease from the affected areas elsewhere failed to unearth additional infected properties. It is believed that the situation with respect to the Boynton outbreak is safe, for no infected trees have been found since early in August, 1920. The Davie situation is being handled in a satisfactory manner. The growers in this community have rendered unqualified support and assistance and have submitted to the necessary quarantine restrictions without murmur. Indeed, this community presents a splendid example of complete cooperation.

No explanation of an entirely satisfactory nature can be offered as to the cause of the Davie outbreak. The most plausible appears to be that the disease "held over" from 1915 either (a) on some old neglected and undiscovered tree, or (b) in the soil. The latter possibility is being given special consideration by the Plant Pathologist of the University of Florida Experiment Station.

Owing to lack of funds from both State and Federal sources, the force of inspectors engaged in grove inspection work had

been reduced to twenty men who were available at the time of the Davie outbreak. In the emergency, the full force was concentrated at Davie and inspectors from other departments of the State Plant Board were drafted for service "on the firing line". The Board felt that this critical situation should receive prompt and vigorous attention, even though this would enforce curtailment of inspection work later on.

Through the efforts of the Florida delegation in Congress and upon representations made by the citrus growers of the State, and by the State Plant Board, a Federal appropriation was secured, available July 1, 1922. Of this appropriation, $70,000.00 was apportioned by the Bureau of Plant Industry for the continuation of work in Florida. This sum supplements the allotment made by the Board from State funds of $60,000.00, and the sum of $5,800.00 from a general federal appropriation. The combined amount will make it possible to continue the campaign against citrus canker throughout the fiscal year of 1922 and 23.

Crews of inspectors engaged in grove inspection work have operated in various parts of the citrus section of Florida, making general inspections of all citrus plantings. Special inspectors have continued investigational work in the areas where citrus canker had formerly been found as well as visited properties upon which had been planted prior to 1915 citrus nursery trees from infected nurseries. No canker infected trees have been found except those reported at Boynton and Davie.

All during the citrus canker eradication work, the State Plant Board has had the warm sympathy and support of the officials of the United States Department of Agriculture, and particularly of Doctor Karl F. Kellerman, Associate Chief of the Bureau of Plant Industry. Mr. Frank Stirling, General Inspector of the State Plant Board, has continued, as in the past, to have charge of the field force engaged in this work.

From May 1, 1920 to April 30, 1921, the expenditures for citrus canker eradication totaled $100,164.70; $61,587.66 of this was from State funds and $38,577.04 from Federal funds. For the fourteen months ending June 30, 1922, $81,555.32 from State sources and $16,944.42 from Federal appropriations were expended.

The sums expended in this work in Florida from its inception are shown in the following tabulation:

	Federal Funds*	State Funds	Other Sources
Prior to May 1, 1920	$860,973.51	$362,258.63	$85,019.62**
May 1, 1920 to April 30, 1922	38,577.04	61,587.66	....
May 1, 1921 to June 30, 1922	16,944.42	81,555.32	....
Totals	$916,494.97	$505,401.61	$85,019.62
Total, all sources			$1,506,916.20***

For convenience of presentation, there are included herewith certain tabulations and charts giving statistical information with reference to the conduct of this phase of the Plant Board work.

Two charts or diagrams are submitted showing graphically the number of canker-infected trees found each month to June 30, 1922 (Fig. 1) and the number of canker-infected properties found in the state for the same period, as well as the number of these which have been declared by the Board to be no longer danger centers with reference to the disease (Fig. 2).

The following tabulation shows the same information as is indicated in the diagram, Fig. 1:

NUMBER OF GROVE TREES FOUND INFECTED WITH CANKER, PER MONTH, SINCE THE WORK BEGAN IN MAY OF 1914

1914		1915		1916		1917		1918		1919		1920		1921		1922	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0	Jan.	0	Jan.	0	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0	Feb.	0	Feb.	0	Feb.	0
		Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1	Mar.	0	Mar.	0	Mar.	0
		Apr.	408	Apr.	49	Apr.	169	Apr.	2	Apr.	1	Apr.	0	Apr.	0	Apr.	0
May	108	May	1042	May	338	May	52	May	1	May	1	May	0	May	0	May	585
June	160	June	772	June	450	June	45	June	10	June	0	June	0	June	0	June	168
July	275	July	651	July	349	July	39	July	0	July	0	July	539	July	0		
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0	Aug.	1	Aug.	1	Aug.	0		
Sept.	767	Sept.	618	Sept.	124	Sept.	6	Sept.	0	Sept.	0	Sept.	0	Sept.	0		
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0	Oct.	0	Oct.	0	Oct.	0		
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0	Nov.	0	Nov.	0	Nov.	0		
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0	Dec.	0	Dec.	0	Dec.	0		
Tot.	4327		6715		2294		372		15		4		540		0		

*Does not include special salary increases provided by Acts of Congress.
**Includes donations from inspectors, transportation companies, growers, etc.
***Includes expenditures directly chargeable to citrus canker eradication.

TABLE I

TABULATED REPORT OF THE CITRUS CANKER ERADICATION DEPARTMENT FOR THE YEAR ENDING APRIL 30, 1921

	Number of trees inspected for citrus canker. (Many trees were reinspected a number of times. The figures below include such reinspections.)		Number of counties in which citrus canker was found.	Number of properties in which citrus canker was found.	Number of trees found infected and destroyed.		Number of "exposed" trees destroyed as a precautionary measure.		Number of properties newly infected.	Number of properties declared no longer actively infected.
	Grove	Nursery			Grove	Nursery	Grove	Nursery		
1920										
May	588,326	4,329,786	0	0	0	0	0	0	0	0
June	319,104	4,769,412	0	0	0	0	0	0	0	0
July	311,883	4,509,662	1	5	539	0	544	15,000	5	0
August	689,336	2,324,622	1	1	1	0	0	17,000	0	0
September	588,416	4,252 933	0	0	0	0	0	0	0	0
October	495,518	5,475,708	0	0	0	0	0	0	0	0
November	341,402	5,090,179	0	0	0	0	0	0	0	0
December	386,468	5,075,177	0	0	0	0	0	0	0	0
1921										
January	373,696	6,021,717	0	0	0	0	0	0	0	2
February	373,696	1,817,216	0	0	0	0	0	0	0	0
March	444.123	6,235,830	0	0	0	0	0	0	0	0
April	701,274	5,046,544	0	0	0	0	0	0	0	0
Totals	5,613,242	54,948,786	1*	5**	540	0	544	32,000	5	2
Prior to May 1, 1920	57,591,061	194,338,472	22	481	13,727	242,254	234,998	2,613,514	481	479
Totals	63,204,303	259,287,258	22	486	14,267	242,254	235,542	2,645,514	486	481

*Infections reported from one county for the year 1920-1921. No newly infected county reported for the year 1920-1921. Total number of counties infected to April 30, 1921, 22.

**Actual number of properties in which infected trees were found during year 1920-1921.

TABLE II

TABULATED REPORT OF THE CITRUS CANKER ERADICATION DEPARTMENT FOR THE PERIOD FROM MAY 1, 1921 TO JUNE 30, 1922

	Number of trees inspected for citrus canker. (Many trees were reinspected a number of times. The figures below include such reinspections.)		Number of counties in which citrus canker was found.	Number of properties in which citrus canker was found.	Number of trees found infected and destroyed.		Number of "exposed" trees destroyed as a precautionary measure.		Number of properties newly infected.	Number of properties declared no longer actively infected.
	Grove	Nursery			Grove	Nursery	Grove	Nursery		
1921										
May	701,539	2.882,009	0	0	0	0	0	0	0	0
June	706,601	1,244,308	0	0	0	0	0	0	0	0
July	496,139	5,272,074	0	0	0	0	0	0	0	0
August	778,858	5,470,050	0	0	0	0	0	0	0	0
September	603,330	7,911,835	0	0	0	0	0	0	0	0
October	479,161	5,974,246	0	0	0	0	0	0	0	0
November	617,552	7,465,765	0	0	0	0	0	0	0	0
December	417,341	4,748,806	0	0	0	0	0	0	0	0
1922										
January	752,520	6,470,216	0	0	0	0	0	0	0	0
February	741,104	6,315,697	0	0	0	0	0	0	0	0
March	608,129	7,149,714	0	0	0	0	0	0	0	0
April	817,289	5,283,850	0	0	0	0	0	0	0	0
May	880,972	6,851,256	1	9	585	0	0	0	9	0
June	99,798	7,936,598	1	8	168	0	0	0	5	0
Totals	8,718,333	80,976,424	1*	14**	753	0	0	0	14	0
Prior to May 1, 1921	63,204,303	259,287,258	22	486	14 267	242,254	235,542	2,645,514	486	481
Totals	71,922,636	340,263,682	22	500	15,020	242.254	235,542	2,645,514	500	481

*Infections reported from one county for the year 1921-1922. No newly infected county reported for the year 1921-1922. Total number of counties infected to June 30, 1922, 22.

**Actual number of properties in which infected trees were found during year 1921-1922.

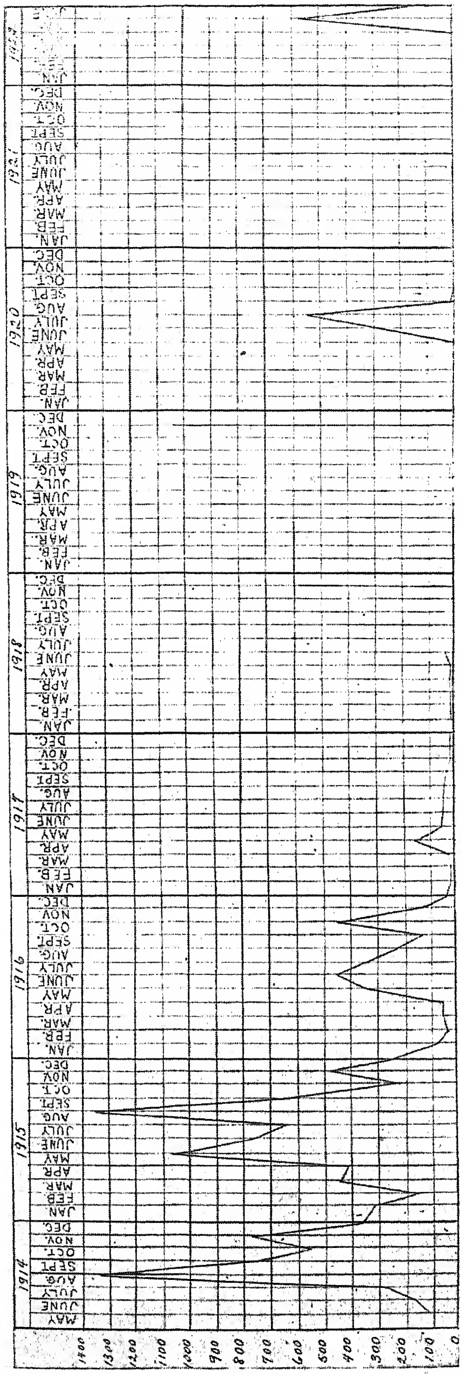

Fig. 1.—Diagram showing the number of canker infected grove trees found in Florida each month from May 15, 1914, to June 30, 1922.

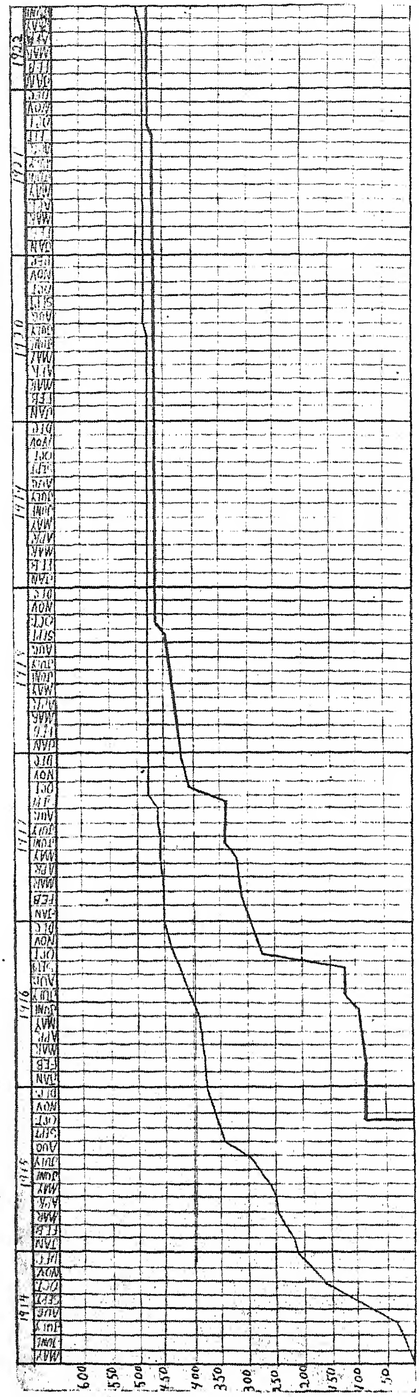

Fig 2.—Comparison of infected properties and properties declared no longer danger centers in Florida at different dates. Light line shows the total number of canker infected properties found in the state up to the end of each month. Heavy line shows the number of infected properties declared by the Plant Board, up to corresponding dates, as being no longer danger centers.

Summary

The following are the essential facts concerning the eradication of citrus canker in Florida up to June 30, 1922:

Total number of properties found infected in the State	500
Total number declared no longer danger centers	481
Number still classed as active infections, June 30, 1922	19
Number of properties declared "clean"	481
Number of properties still under partial or full quarantine, June 30, 1922	19
Total number of grove trees found infected May 1, 1914 to June 30, 1922	15,020
Total number of nursery trees found infected May 1, 1914 to June 30, 1922	342,254
Total number of "exposed" grove trees destroyed, May 1, 1914 to June 30, 1922	235,590
Total number of "exposed" nursery trees destroyed, May 1, 1914 to June 30, 1922	2,645,514

NURSERY INSPECTION DEPARTMENT

Practically all states have some form of inspection of nursery stock and protection against the spread of plant pests into orchards and ornamental plantings. In some states this service is more highly developed than in others. In Florida, owing to the extensive investments in orchards, particularly citrus, and due to climatic conditions which favor the development of insect pests and plant diseases, more frequent and thorough inspections are demanded than in more northern states. It has been the aim of this Department to make four inspections annually of all commercial nurseries. This has not been possible in all cases. Nevertheless it is felt that the Florida Nursery Inspection Service is giving good return to the State for the money expended.

The Florida Service is unique in that it is required that not only must every shipment of nursery stock be accompanied by a certificate of inspection (which is a usual requirement in other states) but must also be reported by the shipper to the Nursery Inspector's office by invoice. Thus, a complete and permanent record of all movements of nursery stock is secured. This record might prove invaluable in event of an outbreak of some serious plant disease or insect pest in some nursery or in grove plantings. Should such an unfortunate situation arise, it will be possible by means of the records filed in the Nursery Inspector's office to

follow up each suspicious or dangerous shipment originating in the affected nursery. Many thousands of dollars would be saved to the State and the growers through this system.

There are now eleven Assistant Nursery Inspectors operating in as many nursery inspection districts. These districts, of course, vary in size geographically. Some are quite large, while others are quite limited as to area. The size depends wholly on the extent of the nursery operations. Each of the Assistant Nursery Inspectors has a designated headquarters. In some of the larger districts, the inspector is in a travel status practically all the time.

The total number of nurseries inspected during the year ending April 30, 1921, was 2,682. The number of inspections made was 5,450.

The total number of nurseries inspected during the year ending April 30, 1922, was 2,947. The total number of inspections was 5,918.

During May and June, 1922, 886 nursery inspections were made. For the full period of twenty-six months, 12,254 inspections were made in 5,739 nurseries.

Refusal or Suspension of Certification

When a condition is found in a nursery which renders the movement of stock therefrom unsafe, certification is refused, or, if a certificate has previously been issued, it is suspended. No certificate is issued or reinstated until the unsatisfactory or dangerous condition is abated.

During the year ending April 30, 1921, there were 666 such refusals or suspensions. During the fourteen months ending June 30, 1922, 772. Five nurseries were refused certification because of their being located within a one mile zone under quarantine on account of citrus canker.

The reasons for refusal or suspension were as follows:

Year Ending April 30, 1921

Reason	*Number*
Avocado scab	15
California red scale	10
Camphor thrips	4
Foot rot of citrus	18
Excessive whitefly and scale	462
San Jose scale	21
Other causes	136
	666

Period Ending June 30, 1922

Reason	*Number*
Avocado scab	22
California red scale	15
Camphor thrips	10
Foot rot of citrus	21
Excessive whitefly and scale	554
San Jose scale	24
Other causes	126
	772

Permit Certificates

Under the Florida law (Section 8 of the Plant Act of 1915) there are certain requirements which must be complied with in order to make shipments of nursery stock into the State. All such shipments are subject to inspection when coming under the observation of inspectors of the Board. Many are handled each year by inspectors of the Quarantine Service. When found to be infected or infested, they are either properly treated or refused delivery.

In order to facilitate movement of stock into the State as well as to have a record of such movements, the certificate or permit provided for in Section 8 of the Plant Act is issued to out-state nurserymen after the Nursery Inspector has been supplied with a signed copy of the certificate issued by the inspector of nursery stock of the state wherein the nursery is located, and has also been supplied with such other information as may indicate the reasonable assurance that shipments may be made with safety. All shipments made under permits must be reported to the Nursery Inspector by invoice just as are shipments made within the State.

During the year ending April 30, 1921, 29,913 permit certificate tags were issued to 173 out-state nurseries. For the fourteen months subsequent to May 1, 1921, 238 nurseries secured 35,777 permit certificate tags.

Spraying Experiments

Although it is not the function of the State Plant Board to conduct experiments in the field of pest control by means of developing new spray formulas, the Board's activities being pri-

marily of a police or regulatory nature, yet it has been found necessary to do some investigational work. One of the principal reasons for refusal or suspension of certification of citrus nursery stock has been the presence of the disease known as citrus scab. Producers of such stock have experienced in the past great difficulty in satisfactorily controlling this condition. In the last report of the Plant Commissioner, mention was made of a series of experiments then being conducted by the Nursery Inspector to determine the value of a combination spray consisting of Bordeaux mixture and oil. These investigations were continued in cooperation with the Pathologist of the Experiment Station, during 1920 and 21. The results have been very satisfactory and coincide with those obtained by investigators of the Bureau of Entomology, U. S. D. A. It has been found that the use of a properly proportioned Bordeaux oil spray will very decidedly reduce scab infection. Indeed, this combination spray has proven quite effective in general grove sprayings and is coming to be accepted by growers as a standard spray mixture for fungous diseases on citrus trees. By its use, there is obviated to a great degree the likelihood of an excessive scale infestation which generally follows the use of plain Bordeaux.

The Following Information as to Certain Details in Connection with the Operation of the Nursery Inspection Department Has Been Prepared by Nursery Inspector O'Byrne from the Records of His Office.

Year Ending April 30, 1921

Inspection Record

Total number of nurseries inspected during the year	2,682
Number of properties that were inspected but once	633
Total number of inspections made during the year	*5,450

The acreage in the nurseries under inspection was as follows on April 30, 1921:

Citrus	1,882.82	
Pecan	328.96	
Avocado	16.08	
Peach	24.77	
Strawberry	105.70	
Ornamental and general	398.28	
		2,756.61

*Most strawberry nurseries were inspected but twice.

The amount of stock (total number of trees and plants) in the nurseries was as follows on April 30, 1921:

Citrus—			
Grapefruit buds	677,439		
Orange buds	1,945,949		
Other buds	109,274		
Unbudded seedlings	15,070,776		
Total citrus stock		17,803,238	
Citrus refused certification (4-30-21)		596,605	
Total marketable citrus stock (4-30-21)			17,206,633
Pecan—			
Budded or grafted	371,685		
Unbudded seedlings	743,370		
Total pecan stock		1,115,055	
Refused certification (4-30-21)		29,770	
Total marketable pecan stock (4-30-21)			1,085,285
Avocado—			
Budded or grafted—not given.			
Unbudded seedlings—not given.			
Total avocado stock		91,925	
Refused certification (4-30-21)		58,930	
Total marketable avocado stock (4-30-21)			32,995
Peach—			
Budded or grafted	75,842		
Unbudded seedlings	118,694		
Total peach stock		194,536	
Refused certification (4-30-21)		812	
Total marketable peach stock			193,724
Strawberry—			
Total strawberry stock (9-1-20)		*8,456,950	
Total strawberry stock refused certification (9-1-20)		43,000	
Total marketable strawberry stock (9-1-20)			8,413,950
General and Ornamental—			
Total general and ornamental stock (4-30-21)		5,231,715	
Refused certification (4-30-21)		23,240	
Total marketable general and ornamental stock			5,208,475

*These figures correct September 1, 1920, as strawberry season is annual affair and plants are all moved before April 30.

Recapitulation

Total stock in Florida nurseries	32,893,419	
Total stock refused certification	752,357	
Total marketable stock in Florida nurseries (4-30-21)		32,141,062

Period from May 1, 1921, to June 30, 1922

Inspection Record

	Year ending April 30, 1922	During May and June	Total for 14-month period
Total nurseries inspected	2,947	110	3,057
Properties inspected but once	1,216	110	1,326
Total number of inspections made	*5,918	*886	*6,804

The acreage in the nurseries under inspection was as follows:

	April 30, 1922	Added in May and June	Total
Citrus	2,674.20	34.25	2,708.45
Pecan	283.12	....	283.12
Avocado	15.37	1.00	16.37
Peach	10.12	....	10.12
Strawberry	247.35	....	247.35
Ornamental and general	531.48	18.44	549.92
	3,761.64	53.69	3,815.33

The amount of stock (total number of trees and plants) in the nurseries was as follows:

	April 30, 1922	Added in May and June	Total
Citrus—			
Grapefruit buds	785,839	6,550	792,389
Orange buds	2,334,248	9,535	2,343,783
Other buds	495,436	1,400	496,836
Unbudded seedlings	19,990,259	583,565	20,573,824
Total citrus stock	23,605,782	601,050	24,206,832
Citrus refused certification	692,180	18,250	710,430
Total marketable citrus stock	22,913,602	582,800	23,496,402
Pecan—			
Budded or grafted	283,000	....	283,000
Unbudded seedlings	459,044	....	459,044
Total pecan stock	742,044	....	742,044
Refused certification	32,000	....	32,000
Total marketable pecan stock	710,044	....	710,044

*Most strawberry nurseries were inspected but twice, also many budwood and special inspections are made but once.

Avocado—			
Budded or grafted	48,000	275	48,275
Unbudded seedlings	66,922	3,000	69,922
Total avocado stock	114,922	3,275	118,197
Refused certification	66,700	....	66,700
Total marketable avocado stock	48,222	3,275	51,497
Peach—			
Budded or grafted	12,500	....	12,500
Unbudded seedlings	26,328	....	26,328
Total peach stock	38,828	....	38,828
Refused certification	9,030	....	9,030
Total marketable peach stock	29,798	....	29,798
Strawberry—			
Total strawberry stock (10-1-21)	19,143,250*	....	19,143,250*
Total strawberry stock refused certification (10-1-21)	217,000*	....	217,000*
Total marketable strawberry stock	18,926,250*	....	18,926,250*

	April 30, 1922	Added in May and June	Total
General and ornamental stock	5,644,908	280,225	5,925,133
Refused certification	324,395	1,000	325,395
Total marketable general and ornamental stock	5,320,513	279,225	5,599,738

Recapitulation

Total stock in Florida nurseries	49,289,734	884,550	50,174,284
Total stock refused certification	1,341,305	19,250	1,360,555
Total marketable stock in Florida nurseries	47,948,429	865,300	48,813,729

Certification Refusals

The policy of the Department as regards refusals to certify nurseries has been continued on the same basis as during the two years past. For a detailed description, see those reports.

During the fourteen months period, nurseries were refused certification as follows:

*These figures are correct October 1, 1921, as the strawberry season is an annual affair and the plants are all moved before April 30. The requirement that strawberry plants be inspected was repealed by the Board in April, 1922.

Reason	Number of Occasions During Year	During May and June	Total
Avocado scab	20	2	22
California red scale	11	4	15
Camphor thrips	8	2	10
Foot rot of citrus	13	8	21
Excessive whitefly and scale	459	95	554
San Jose scale	20	4	24
Other causes	107	19	126
Total	638*	134*	772*

On April 30, 1922, there were 268 Florida nurseries refused certification. By June 30, 1922, this number had been increased to 296.

CERTIFICATES ISSUED

Certificate tags were issued as follows:

Year Ending April 30, 1921

Kind of Tag	Total Number Tags Issued	Number Persons and Firms
Regular tags	78,942	765
Scaly bark tags	3,245	112
Package tags	1,913	1,434
Stock dealer's tags	4,951	10
Permit tags	29,913	173
	118,964	2,494

Period from May 1, 1921, to June 30, 1922

Kind of Tag	Issued During Year	Issued During May and June	Total	No. Persons and Firms During Year	During May and June	Total
Regular tags	97,027	10,162	107,189	1,218	140	1,358
Scaly bark tags	2,355	71	2,426	99	8	107
Package tags	3,182	705	3,887	2,386	528	2,914
Stock dealer's tags	5,400	100	5,500	17	1	18
Permit tags	35,144	633	35,777	234	4	238
	143,108	11,671	154,779	3,954	681	4,635

QUARANTINE DEPARTMENT

The only protection which Florida has against the entry of plant pests from abroad or from other states is in the application of the quarantine rules of the State Plant Board and of the Federal Horticultural Board. There are insect pests and plant

*This includes refusals for both commercial and non-commercial nurseries. Some nurseries are practically abandoned and are refused four times a year, once for each inspection made.

diseases present in certain foreign lands, particularly the tropical countries adjacent to Florida, which if introduced would without question occasion untold losses. For instance, in Cuba is the much dreaded spiny citrus whitefly, commonly called the blackfly. This same pest is in Jamaica and the Bahamas, as well as some Central American countries. In Cuba is also the West Indian fruit fly, which attacks and ruins for market such fruits as citrus, mangoes and guavas. In Mexico are the Morelos fruit worm, which damages citrus fruits, and the avocado weevil, which attacks avocados.

In various of the states of the United States dangerous plant pests of one kind or another have gained foothold. It is the duty of inspectors of the Quarantine Department to protect the state against entry of such pests. There are an insufficient number of inspectors attached to this service to adequately perform the duty. The number of men should be greatly increased.

Our inspectors are collaborators of the Federal Horticultural Board, at nominal salaries, and administer the plant quarantine regulations of the national government along with those of the state. By reason of the federal appointment additional authority is secured and greater protection afforded Florida's agricultural interests.

The preceding biennial report mentioned the fumigating facilities which had been provided at Key West and Port Tampa for the purpose of administering a fumigant (hydrocyanic acid gas) to shipments of fruits and vegetables originating in the West Indies and other tropical countries and destined for delivery in Florida. There are large commercial movements of such material, particularly from Cuba, and the danger of importing plant pests in this manner is great. The fumigating plants at Key West and Port Tampa have been operated satisfactorily and efficiently. Since the last report a similar plant has been put into operation at Miami. This plant is located on the city dock and was constructed by the city of Miami for the use of the State Plant Board. The fumigating plants at Key West and Port Tampa were constructed for our use by the transportation companies, i. e., Florida East Coast Railroad, Atlantic Coast Line Railroad and the Peninsular & Occidental Steamship Company. This is an illustration of the cooperative relations existing between the operatives of the Board and the transportation companies. During the twenty-six months ending June 30, 1922, 136,072 packages were fumigated.

Following is a summary of the quarantine inspection work for the year ending April 30, 1921, and the fourteen months period ending June 30, 1922.

During the year ending April 30, 1921, 89 insect pests and 9 plant diseases were intercepted on material arriving at Florida ports from 21 foreign countries.

1921

1. Africa
2. Australia
3. Bahamas
4. Brazil
5. British Honduras
6. Canal Zone
7. Canary Islands
8. Chile
9. Colombia
10. Cuba
11. Grand Cayman
12. Hawaii
13. Isle of Pines (Cuba)
14. Jamaica
15. Mexico
16. Nicaragua
17. Porto Rico
18. Santo Domingo
19. Scotland
20. Spanish Honduras
21. Spain

During the fourteen months ending June 30, 1922, 104 insect pests and 7 plant diseases were intercepted on material arriving at Florida ports from 35 foreign countries.

1922

1. Africa
2. Bahamas
3. Belgium
4. Bermuda
5. British West Indies
6. Cuba
7. Dominica
8. Dutch West Indies
9. Ecuador
10. Eng and
11. France
12. Germany
13. Grand Cayman
14. Hawaii
15. Holland
16. Honduras
17. India
18. Ireland
19. Isle of Pines (Cuba)
20. Jamaica
21. Java
22. Mexico
23. Nicaragua
24. Norway
25. Palestine
26. Panama
27. Peru
28. Portugal
29. Scotland
30. Seychelles
31. Spain
32. Spanish Honduras
33. Venezuela
34. Wales
35. Windward Isles

The most important of the pests intercepted were:

Insect or Disease	From	Number of Shipments Infested
Argentine ant	Louisiana	1
Aspidiotus destructor Sign.	Cuba	52
Aspidiotus orientalis Newst.	Cuba and Colombia	84
Aleurocanthus woglumi Ashby (blackfly)	Cuba and Bahamas	15
Diplodia cacaoicola P. Herm.	Santo Domingo	1
Pseudaonidia duplex (Ckll.) (camphor scale)	Louisiana	1
Pseudaonidia paeoniae (Ckll.)	Georgia	1
Pseudaonidia tesserata (de Charm)	Cuba	3
Pseudococcus sacchari Ckll.	Cuba	1
Pyralid, *Plodia* sp.	India	1
Strawberry crown borer	Georgia and Arkansas	5
Targionia hartii (Ckll.)	Grand Cayman	2
Targionia sacchari (Ckll.)	West Indies	39
Vinsonia stellifera Westw.	Bahamas	2
West Indian fruit fly	Cuba	14

THE FOLLOWING TABULATION IS PRESENTED SHOWING THE WORK OF THE QUARANTINE DIVISION BY YEARS SINCE THIS WORK WAS INAUGURATED

	1915-16	1916-17	1917-18	1918-19	1919-20	1920-21	1921-22	May and June, 1922	Total
Foreign boats	166	1240	1777	1724	2458	3035	2225	364	12989
Total boats	370	3257	4253	3485	4504	4948	4179	697	25693
No. packages arriving by boat, express, freight, mail	500	3105	3422	*69985	336059¾	710412½	1333333½	747972	3204789¾
Number packages returned	18	255	485	1521	4936½	2130½	2610	201	12157
Number packages destroyed	69	1182	1037½	1743¾	2345½	1564⅓	1757	311	9989

*Prior to August 1, 1918, horticultural material inspected was reported by shipments. A shipment might comprise 1 or 1,000 packages. Subsequent to above date reports were made of the number of packages and bulk shipments were reduced to packages on basis of contents of standard containers used for particular products.

Quarantine Inspector's Summary for the Year Ending April 30, 1921

Ships and Vessels Inspected:		
From foreign ports		3035
From U. S. ports other than Florida		1425
From Florida ports		524
Total		4,984
Number of Parcels Inspected:		
Arriving by water:		
Passed	644,183	
Treated and passed	54,464	
Returned to shipper	1,851½	
Contraband destroyed	1,285	
Total		701,783½
Arriving by land: Express, freight, wagon, etc.:		
Passed	10,314⅙	
Treated and passed	226½	
Returned to shipper	183	
Contraband destroyed	256⅓	
Total		10,980
Arriving by mail:		
Passed	1,180	
Treated and passed	45	
Returned to shipper	96	
Contraband destroyed	23	
Total		1,344
Grand Total of Parcels Inspected		714,107

Principal Pests and Diseases Intercepted

Shipments by all means of transportation except parcel post
For year ending April 30, 1921

Insect or Disease	Occurring on	From	Number of Shipments Infested
Aleyrodid eggs	Citrus	Isle of Pines	1
Ant	Soil	Bahamas	1
Ant	Sugar cane	Cuba	1
Ant	Yam	Nicaragua	1
Ant	Unknown	Mexico	1
Ants	Sugar cane	Mexico	1
Ants	Yam	Cuba	2
Ants	Unknown	Cuba	1
Anthracnose	Jamaica apple	Cuba	1
Araucaria ericoccus	*Araucaria excelsa*	California	1
Aspidiotus destructor Sign.	Coconut	Cuba	21
Aspidiotus destructor Sign.	Vine	Cuba	1
Aspidiotus destructor Sign.	Coconut	Porto Rico	1
Aspidiotus fabernii Houser	Sugar apple	Cuba	1
Aspidiotus lataniae Sign.	Coconut	Cuba	1
Aspidiotus orientalis Newst.	Banana	Cuba	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Aspidiotus orientalis Newst.	Carnation	Florida	1
Aspidiotus orientalis Newst.	Coconut	Columbia	1
Aspidiotus orientalis Newst.	Coconut	Bahamas	1
Aspidiotus orientalis Newst.	Coconut	Cuba	37
Aspidiotus orientalis Newst.	Coconut	Mexico	1
Aspidiotus orientalis Newst.	Coconut	Nassau	1
Aspidiotus orientalis Newst.	Oleander	Florida	2
Aspidiotus orientalis Newst.	Rose	Florida	2
Aspidiotus orientalis Newst.	Sugar apple	Cuba	1
Aspidiotus orientalis Newst.	Unknown semi-aerial	Florida	1
Aspidiotus palmae Morg. & Ckll.	Mango	Span. Honduras	1
Aspidiotus spinosus Comst.	Rose	Nassau	1
Aspidiotus sp.	Grape	North Carolina	1
Aspidiotus sp.	Coconut	Span. Honduras	1
Aspidiotus sp.	Guava	Cuba	1
Aspidiotus sp.	Mango (leaf)	Span. Honduras	1
Aspidiotus sp.	Oleander	Cuba	1
Aspidiotus sp.	Spanish Lime	Cuba	1
Aspidiotus sp.	Sugar apple	Nassau	1
Aspidiotus subsimilis var. *anonae* Houser	Ceba (?) cuttings	Cuba	1
Aspidiotus subsimilis var. *anonae* Houser	Hog plum (?)	Florida	1
Aspidiotus subsimilis var. *anonae* Houser	Palm	Cuba	1
Aspidiotus subsimilis var. *anonae* Houser	Soursop	Nassau	1
Aspidiotus subsimilis var. *anonae* Houser	Unknown	Cuba	1
Aspidistra scale	Fern	Pennsylvania	1
Aspidistra scale	Sisal plants	Cuba	1
Aspidistra scale	Soft plant	Spain	1
Asterolecanium sp.	Coconut	Span. Honduras	1
Balsam gall midge	Spruce	Massachusetts	1
Bamboo scale	Bamboo	Cuba	1
Beetle, *Cathartus gemellatus* Duv.	Corn	Africa	1
Beetle, *Scymnus* sp.	Rose	New Jersey	1
Beetle, *Silvanus surinamensis* L.	Dates	Chile, S. A.	1
Beetle, *Tribolium ferrugineum* Fab.	Dates	Chile, S. A.	1
Beetle	Oranges	Canary Islands	1
Beetle	Palm seed	Australia	1
Beetle larva	Soil	Pennsylvania	1
Beetle	Sugar cane	Cuba	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Beetle	Sweet potatoes	Canal Zone	1
Beetle	Sweet potato	Cuba	1
Blackfly	Lime	Cuba	2
Blackfly	Orange	Cuba	1
Blackfly	Sapodilla	Nassau	1
Black Melanose	Citrus	Cuba	4
Black Melanose	Citrus	Isle of Pines	1
Black Melanose (?)	Citrus	Span. Honduras	1
Black Melanose	Lemon	Cuba	1
Black Melanose	Lime	Cuba	1
Black scale	Citrus	Spain	1
Black scale	Grape	Florida	1
Black scale	Mamey	Cuba	1
Black scale	Olive ?	California	1
Black scale	Sapodilla	Bahamas	1
Black scale	Soursop	Nassau	3
Black scale	Sweet olive	Louisiana	1
Black scale	Unknown	Cuba	1
Black scale	Unknown	Florida	1
Black thread scale	Palms	Cuba	1
Boisduval's scale	Coconut	Cuba	13
Boisduval's scale	Coconut	B. I.	1
Boisduval's scale	Orchid	New York	2
Boisduval's scale	Palm	B. I.	1
Boisduval's scale	Palm	New York	1
Boisduval's scale	Unknown	New York	1
Boisduval's scale	Unknown	Porto Rico	1
Borer injury	Sugar cane	Cuba	2
Cactus scale	Cactus	New York	1
Camphor thrips	Camphor	Florida	1
Cephalosporium sp.	Corn (green)	Cuba	1
Chaff scale	Asparagus fern	Cuba	1
Chaff scale	Citrus	Cuba	2
Chaff scale	Citrus	Florida	3
Chaff scale	Croton	Cuba	1
Chaff scale	Grapefruit	Isle of Pines	1
Chaff scale	Japonica	Florida	1
Chaff scale	Limes	British Honduras	1
Chaff scale	Orange	Spain	1
Chalcid	Jamaica apple	Cuba	1
Cherry scale	Peach	Georgia	1
Cherry scale	Plum	Georgia	1
Cherry scale	Plum	North Carolina	2
Chrysomelid beetle	Common box tree	New Jersey	1
Chrysomphalus mimosae (Comst.)	Hog plum	Florida	1
Chrysomphalus sp.	Lime	Span. Honduras	1
Cloudy-winged white-fly	Citrus	Cuba	4
Cloudy-winged white-fly	Citrus	Florida	1
Cloudy-winged white-fly	Lime	Cuba	1
Coccid	Cactus	New York	1
Coccus sp.	Sapodilla	Cuba	1
Coccus sp.	Sapodilla leaves	Nassau	1
Coconut mealy-bug	Custard apple	Cuba	1
Coconut mealy-bug	Palm	Cuba	2

Insect or Disease	Occurring on	From	Number of Shipments Infested
Coconut mealy-bug	Soursop	Nassau	2
Coffee-bean weevil	Sugar cane	W. Africa	1
Coffee-bean weevil	Unknown pods & seed	W. Africa	1
Coleopteron larvae ?	Corn ear	Nassau	1
Coleopteron larvae	Sour orange	British Honduras	1
Common mealy-bug	Cactus	New York	1
Common mealy-bug	Hawaiian Kukin Nut Tree	New York	1
Common mealy-bug	Sweet potato vines	Florida	1
Common whitefly	Citrus	Alabama	1
Common whitefly	Citrus	Florida	10
Common whitefly	Cape jasmine	Florida	1
Common whitefly	Cape jasmine	Unknown	1
Common whitefly	Citrus	Georgia	1
Common whitefly	Jasmine	Florida	1
Common whitefly	Privet	Georgia	1
Conchaspis angraeci Ckll.	Croton	Cuba	1
Conchaspis angraeci Ckll.	Croton	Florida	4
Conchaspis angraeci Ckll.	Hibiscus	Florida	2
Corn ear worm	Corn	Nassau	1
Corn ear worm	Tomato	Nassau	1
Cottony bamboo scale	Bamboo	California	1
Cottony cushion-scale	Oleander	Florida	1
Cottony cushion-scale	Acacia	New York	1
Cottony cushion-scale	Rose	Florida	2
Crown gall	Peach	Ohio	1
Crown gall	Plum	Alabama	1
Crown gall	Raspberry	New York	1
Crown gall	Rose	Illinois	4
Crown gall	Rose	New York	2
Cucujid beetle	Corn	Cuba	1
Cyanophyllum scale	Eucalyptus	Cuba	1
Dictyospermum scale	Century plant	Virginia	1
Dictyospermum scale	Citrus	Florida	1
Dictyospermum scale	Grapefruit	Nassau	1
Dictyospermum scale	Limes	British Honduras	1
Dictyospermum scale	Mango (leaf)	Span. Honduras	1
Dictyospermum scale	Palm	Florida	1
Dictyospermum scale	Rose	Nassau	1
Dictyospermum scale	Vine	New Jersey	1
Diplodia natalensis (fungus)	Coconut	Cuba	2
Diplodia natalensis (fungus)	Coconut	Nassau	1
Dipterous larvae	Limes	British Honduras	1
Dipterous larvae	Orange	Nicaragua	1
Dipterous larvae ?	Sapodilla	Bahamas	1
Dipterous larvae	Unknown	Cuba	1
Eggs of mite or aphid	Birch	New York	1
English walnut scale	Plum	Florida	1
English walnut scale	Walnut	Ohio	1
Euonymus scale	Euonymus	Unknown	1
European fiorinia	Coconut	Florida	1
Florida red scale	Banana	Cuba	2
Florida red scale	Camphor	Florida	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Florida red scale	Citrus	Cuba	2
Florida red scale	Citrus	Florida	2
Florida red scale	Coconut	Hawaii	1
Florida red scale	Grapefruit	Isle of Pines	1
Florida red scale	Lime	Cuba	1
Florida red scale	Mamey	Cuba	1
Florida red scale	Norfolk Island Pine	Indiana	1
Florida red scale	Oleander	Florida	2
Florida red scale	Palm	Cuba	3
Florida red scale	Rose	Florida	1
Florida red scale	Sweet olive	Louisiana	1
Florida red scale	Unknown	Cuba	1
Florida wax scale	Jasmine	Florida	1
Florida wax scale	Mango (leaf)	Span. Honduras	1
Florida whitefly	Guava	Florida	1
Florida whitefly	Mamey	Cuba	1
Fungus-*Diplodia cacaoicola* P. Henn.	Cocoa bean pod	Santo Domingo	1
Fungus-*Diplodia natalensis* ?	Coconut	Cuba	1
Fungus-*Diplodia* sp. ?	Coconut	W. Africa	1
Fungus-*Graphiola phoenicis*	Palm	Florida	1
Gray garden slug	Citrus	New York	1
Gray-headed scale fungus	Chaff scale	Cuba	1
Gray-headed scale fungus	Purple scale	Cuba	1
Grape Phylloxera (?)	Grape	Washington	1
Greenhouse orthezia	Coleus	Pennsylvania	1
Hemichionaspis sp.	Jasmine-like plant	Africa	1
Hemipteron	Dates	Chile, S. A.	1
Hemispherical scale	Bougainvillea	Florida	1
Hemispherical scale	Century plant	Virginia	1
Hemispherical scale	*Eugenia australis*	California	1
Hemispherical scale	Jasmine	Florida	1
Hemispherical scale	Mamey	Cuba	1
Hemispherical scale	Palm	Cuba	1
Hemispherical scale	Spanish lime	Cuba	1
Hemispherical scale	Stephanotus vine	Florida	1
Hemispherical scale	Unknown	Cuba	1
Hemispherical scale	Unknown	Florida	1
Ivy scale	Banana	Cuba	2
Ivy scale	Chinaberry	Florida	3
Ivy scale	Palm	Florida	4
Latania scale	Banana	Cuba	1
Latania scale	Ceba (?) cuttings	Cuba	1
Latania scale	Fern	Florida	1
Latania scale	Fig	Georgia	1
Latania scale	Fig	Florida	1
Latania scale	Grape	Florida	1
Latania scale	Guava	Florida	1
Latania scale	Japonica	New York	1
Latania scale	Jasmine-like plant	Africa	1
Latania scale	Mamey	Cuba	1
Latania scale	Palm	Cuba	1
Latania scale	Palm	Florida	1
Latania scale	Rose	Arkansas	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Latania scale	Rose	Florida	4
Latania scale	Sago palm	Cuba	1
Latania scale	Sapodilla	Bahamas	1
Latania scale	Sapodilla	Nassau	1
Latania scale	Unknown	Cuba	2
Latania scale	Unknown	New York	1
Lecanium sp.	Orchid	New York	1
Lecanium sp.	Unknown	Ohio	1
Lepidopterous egg mass	Deciduous leaves	Massachusetts	1
Lepidopterous pupa	Soil	Pennsylvania	1
Lepidopterous pupa case	Coconut	Span. Honduras	1
Lepidopterous larva	Conifer	Massachusetts	1
Lepidosaphes hawaiiensis (Mask)	Jasmine like plant	Africa	1
Lepidosaphes sp.	Coconut	Cuba	1
Lepidosaphes sp.	Palm	Cuba	1
Lesser snow scale	Cactus	Florida	1
Lesser snow scale	Cassava	Florida	1
Lesser snow scale	Ceba (?) cuttings	Cuba	1
Lesser snow scale	Coconut	Cuba	3
Lesser snow scale	Coconut	W. Africa	1
Lesser snow scale	Japanese lantern plant	Nassau	1
Lesser snow scale	Oleander	Florida	1
Lesser snow scale	Palm	Cuba	3
Lesser snow scale	Soursop	B. I.	1
Lesser snow scale	Sugar apple	Bahamas	1
Lesser snow scale	Sugar apple	Cuba	1
Liparid moth egg mass	Conifer	Massachusetts	1
Long scale	Limes	British Honduras	1
Long-tailed mealy-bug	Avocado	New York	1
Long-tailed mealy-bug	Caladium	Virginia	1
Long-tailed mealy-bug	Citrus	New York	1
Long-tailed mealy-bug	Croton	Bahamas	1
Long-tailed mealy-bug	Japonica	New York	1
Long-tailed mealy-bug	*Sibocedrus decurrens*	California	1
Long-tailed mealy-bug	Orchid	Cuba	1
Long-tailed mealy-bug	Palm	Cuba	1
Long-tailed mealy-bug	Palm	New York	2
Long-tailed mealy-bug	Soursop	B. I.	1
Long-tailed mealy-bug	Vine	Cuba	1
Long scale	Lime	Cuba	1
Mealy-bug	Caladiums	Cuba	1
Mealy-bug	Croton	Florida	2
Mealy-bug	Fern	Florida	1
Mealy-bug	Hog plum	Florida	1
Mealy-bug	Mamey	Cuba	1
Mealy-bug	Oleander	Florida	2
Mealy-bug	Orange	Spain	1
Mealy-bug	Soursop	Nassau	1
Mealy-bug	Sugar cane	Cuba	1
Mealy-bug—*Pseudococcus sacchari* Ckll.	Sugar cane	Cuba	1
Mealy-bug	Sweet potato draws	Florida	1
Mealy-bug	Unknown	Nassau	1
Mealy-bug	Unknown	Pennsylvania	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Mealy-bug	Yam	Santo Domingo	1
Millipedes	Soil	Cuba	1
Mining scale	Coffee	Costa Rica	1
Mining scale	Coffee	Cuba	1
Mining scale	Fig	Cuba	1
Mining scale	Mammee apple	Cuba	2
Mining scale	Mammee	Nassau	2
Mining scale	Papaya	Cuba	1
Mining scale	Sapodilla	Bahamas	1
Mining scale	Sugar apple	Cuba	1
Mining scale	Sugar apple	Bahamas	1
Mining scale	Unknown	Cuba	1
Mite—*Tetranychus* sp.	Croton	Bahamas	1
Mite—*Tetranychus* sp.	Rose	Bahamas	1
Mite	Rose	Cuba	1
Mite	Unknown	Cuba	1
Mite	Unknown	New York	1
Mite—*Tetranychus* sp.	Coconut	Panama	1
Mite—*Tetranychus* sp.	Coconut	Span. Honduras	1
Moth, *Diatraea* sp.	Sugar cane	Cuba	8
Moth borer—*Diatraea saccharalis*	Sugar cane	Cuba	1
Moth borer	Sugar cane	Cuba	4
Mulberry whitefly	Bougainvillea	Florida	1
Mulberry whitefly	Jessamine	Florida	1
Nectria cinnabarina (Tode) Fr.	Gooseberry	New York	1
Obscure scale	Hog plum (?)	Florida	1
Odonaspis sp.	Ornamental	Florida	1
Oyster shell scale	Common box tree	New Jersey	1
Oyster shell scale	Lilac	New Jersey	1
Oyster shell scale	Peach	Indiana	1
Oyster shell scale	Plum	Indiana	1
Oyster shell scale	Plum or birch (?)	Massachusetts	1
Oyster shell scale	Rose	New Jersey	1
Oyster shell scale	Shrub	Pennsylvania	1
Oyster shell scale	Unknown	New York	1
Oyster shell scale	Unknown	Ohio	1
Palmetto scale	Palm	Florida	1
Parlatoria-like scale	Palmetto	Florida	1
Parlatoria-like scale	Unknown	Nassau	1
Parlatoria-like scale	Unknown	South Carolina	1
Parlatoria sp.	Citrus	Isle of Pines	1
Parlatoria sp.	Limes	Honduras	1
Peach tree borer ?	Peach	Florida	1
Peach tree borer	Peach	Georgia	2
Phylloxera (?)	Grape	New York	1
Pineapple disease	Sugar cane	Cuba	1
Pineapple fungus	Sugar cane	Cuba	1
Pineapple mealy-bug	Breadfruit	Cuba	1
Pineapple scale	Cactus	Florida	1
Pineapple scale	Jessamine	Florida	1
"Pomace Fly", Family Drosophilidae	Limes	Honduras	1
"Pomace Fly", larvae Drosophilidae	Sweet potato	Florida	1
Powdery scab	Irish potato	Scotland	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Pseudaonidia duplex (Ckll.)	Sweet olive	Louisiana	1
Pseudaonidia tesserata (deCharm)	Palm	Bahamas	1
Pseudaonidia tesserata (deCharm)	Palm	Cuba	1
Pseudischnaspis alienus Newst.	Guava	Cuba	1
Pseudischnaspis alienus Newst.	Mamey	Cuba	1
Pseudischnaspis alienus Newst.	Palm	Cuba	1
Pseudischnaspis alienus Newst.	Rose	Florida	1
Pseudischnaspis alienus Newst.	Spanish bayonet	Cuba	1
Pseudischnaspis alienus Newst.	Sugar apple	Cuba	2
Pseudischnaspis sp.	Rose	Nassau	1
Pseudoparlatoria parlatorioides	Unknown	Cuba	1
Psocid	Coconut	Span. Honduras	1
Purple mite	Citrus	Florida	2
Purple scale	Citrus	Cuba	15
Purple scale	Citrus	Florida	7
Purple scale	Citrus	Isle of Pines	4
Purple scale	Croton	Bahamas	1
Purple scale	Grapefruit	Isle of Pines	2
Purple scale	Grapefruit	Mexico	1
Purple scale	Grapefruit	Nassau	1
Purple scale	Lemon	Cuba	1
Purple scale	Limes	British Honduras	1
Purple scale	Lime	Columbia	1
Purple scale	Lime	Cuba	5
Purple scale	Oranges	Canary Islands	1
Purple scale	Orange	Cuba	1
Purple scale	Orange	Spain	1
Purple scale	Palm	Florida	1
Purple scale	Sour orange	British Honduras	1
Pustule scale	Fig	Florida	2
Pustule scale	Jasmine	Cuba	1
Pustule scale	Jasmine	Florida	2
Pustule scale	Oleander	Cuba	1
Pustule scale	Oleander	Florida	7
Pustule scale	Sapodilla	Bahamas	1
Pustule scale	Sapodilla	Nassau	1
Pustule scale	Spanish bayonet	Cuba	1
Pustule scale	Vine	Cuba	1
Putnam's scale	Currant	Iowa	1
Putnam's scale ?	Grape	Florida	1
Pyriform scale	Guava	Florida	3
Pyriform scale	Jasmine	Florida	1
Pyriform scale	Mango (leaf)	Span. Honduras	1
Red-headed scale fungus	Purple scale	Cuba	5
Rice weevil	Palm seed	Australia	1
Rice weevil	Sweet potato	Louisiana	1
Root knot	Fig	Alabama	3

Insect or Disease	Occurring on	From	Number of Shipments Infested
Root knot	Fig	Florida	12
Root knot	Fig	Georgia	10
Root knot	Fig	North Carolina	1
Root knot	Fig	South Carolina	5
Root knot	Fig	Unknown	1
Root knot ?	Grape	New Jersey	1
Root knot	Mulberry	Florida	1
Root knot	Oleander	Florida	1
Root knot	Peach	Alabama	1
Root knot	Peach	Florida	4
Root knot	Peach	Georgia	2
Root knot	Peach	South Carolina	1
Root knot	Rose	Unknown	1
Root knot	Unknown shrub	Florida	1
Root knot	Unknown	Florida	2
Root knot	Unknown	Georgia	1
Root knot	Unknown	South Carolina	1
Root knot	Unknown	Virginia	1
Root-worms	Strawberry	Indiana	1
Rose scale	Blackberry	Georgia	1
Rose scale	Dewberry	Georgia	1
Rose scale	Himalaya berry	Georgia	1
Rose scale	Rose	Florida	1
Rose scale	Rose	Louisiana	2
Rose scale	Rose	New York	1
Rufous scale	Coconut	Span. Honduras	1
Rufous scale	Coffee	Cuba	1
Rufous scale	Croton	Cuba	1
Rufous scale	Grapefruit	Nassau	1
Rufous scale	Lime	Cuba	3
Rufous scale	Mamey	Cuba	1
Rufous scale	Oleander	Cuba	1
Rufous scale	Oleander	Florida	2
Rufous scale	Palm	Cuba	1
Rufous scale	Palm	Florida	1
Rufous scale	Pandanus	Florida	1
Rufous scale	Rose	Florida	3
Rufous scale	Rose	Nassau	1
Rufous scale	Sapodilla	Nassau	1
Rufous scale	Soursop	Nassau	1
Rufous scale	Spanish lime	Nassau	1
Rufous scale	Star apple	Bahamas	1
Rufous scale	Sugar apple	Nassau	1
Rufous scale	Tamarind	Bahamas	1
Rufous scale	Tamarind	Cuba	1
San Jose scale	Apple	Alabama	1
San Jose scale	Apple	South Carolina	1
San Jose scale	Citrus	Alabama	1
San Jose scale	Fig	Georgia	1
San Jose scale	Gooseberry	Ohio	1
San Jose scale	Grape	Georgia	1
San Jose scale	Palm	Georgia	1
San Jose scale	Peach	Alabama	1
San Jose scale	Peach	Florida	2
San Jose scale	Peach	Georgia	1
San Jose scale	Peach	Kentucky	1
San Jose scale	Peach	North Carolina	1
San Jose scale	Peach	South Carolina	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
San Jose scale	Peach	Tennessee	1
San Jose scale	Pear	Florida	1
San Jose scale	Plum	Alabama	1
San Jose scale	Plum	Florida	3
San Jose scale	Plum	Georgia	4
San Jose scale	Plum	South Carolina	2
San Jose scale	Prune ?	Ohio	1
San Jose scale	*Rhubus* sp. (?)	Illinois	1
San Jose scale	Rose	Florida	1
San Jose scale	Rose	Georgia	1
San Jose scale	Rose	Virginia	1
San Jose scale	Rose	Unknown	1
San Jose scale	Unknown	Alabama	1
Scab—*Cladosporium citri* Massee	Limes	British Honduras	1
Scale (?)	Fruit (?)	Nassau	1
Scurfy scale	Currant ?	Iowa	1
Scolytid beetle	Date seeds	Chile, S. A.	1
Seed insect (?)	Mango (leaf)	Span. Honduras	1
Snow scale	Citrus	Cuba	1
Snow scale	Lime	Cuba	1
Snow scale	Orange	Brazil	1
Soft brown scale	Century plant	Virginia	1
Soft brown scale	Citrus	Cuba	2
Soft brown scale	Citrus	Florida	1
Soft brown scale	Citrus	Georgia	1
Soft brown scale	Citrus	New York	1
Soft brown scale	Fern	Cuba	1
Soft brown scale	Fig	Georgia	1
Soft brown scale	Norfolk Island pine	Indiana	1
Soft brown scale	Papaya	Cuba	1
Soft brown scale	Rose	Bahamas	1
Soft brown scale	Smart weed (?)	Florida	1
Soft brown scale	Vine	New Jersey	1
Soft brown scale	Unknown	South Carolina	1
Soft rot	Jamaica apple	Cuba	1
Soft scale	Croton	Bahamas	1
Soft scale	Palm	Cuba	1
Soft scale—*Lecanium* sp.	Orchid	New York	1
Sow bugs	Soil	Cuba	1
Spider eggs	Coconut	Span. Honduras	1
Spotting ?	Mango leaves	Bahamas	1
Stellate scale	Sapodilla	Cuba	1
Subfamily Diaspinae scale	Custard apple	Cuba	1
Sugar cane borer	Sugar cane	Mexico	1
Sugar cane moth borer	Sugar cane	Bahamas	1
Sugar cane moth borer	Sugar cane	Cuba	7
Sweet potato weevil	Sweet potato	Bahamas	2
Sweet potato weevil	Sweet potato	Cuba	16
Sweet potato weevil	Sweet potato	Florida	5
Sweet potato weevil	Sweet potato	Mexico	1
Sweet potato weevil	Sweet potato	Nassau	1
Sweet potato weevil	Sweet potato	Isle of Pines	1
Sweet potato weevil	Sweet potato	Porto Rico	1
Targionia sacchari (Ckll.)	Sugar cane	Bahamas	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Targionia sacchari (Ckll.)	Sugar cane	British Honduras	1
Targionia sacchari (Ckll.)	Sugar cane	Cuba	2
Targionia sacchari (Ckll.)	Sugar cane	Nassau	4
Targionia sacchari (Ckll.)	Sugar cane	Grand Cayman	1
Termite	Sea grape	Isle of Pines	1
Thielaviopsis paradoxa (d. Seyn.)	Sugar cane	Cuba	1
Thrip	Coconut	Cuba	4
Thrips	Coconut	Cuba	1
Thrip	Palm	Cuba	1
Unknown	Potato	Scotland	1
Vinsonia stellifera scale	Sapodilla	Nassau	1
Weevil (*Palaeopus costicollis* Marshall	Yam	Jamaica	2
West Indian fruit fly	Cuban plum	Cuba	3
West Indian fruit fly	Guava	Cuba	5
West Indian fruit fly	Mango	Cuba	1
West Indian fruit fly	Peru guavas	Cuba	1
W. I. sweet potato weevil	Sweet potato	Bahamas	2
Whitefly	Eucalyptus	Cuba	1
Whitefly	Unknown	Cuba	1
White peach scale	Peach	Florida	2
White peach scale	Plum	Florida	2
Withertip	Citrus	New York	1
Withertip	Lime	Cuba	1
Withertip	Citrus	Florida	1
Woolly apple aphis	Apple	Alabama	1
Woolly whitefly	Citrus	Cuba	3
Woolly whitefly	Citrus	Isle of Pines	1
Woolly whitefly	Lime	Cuba	2
"Worms"	Yam	Isle of Pines	1
Yam scale—*Targionia hartii* (Ckll.)	Yam	Grand Cayman	1
Yam Scale—*Targionia hartii* (Ckll.)	Yam	Span. Honduras	1

PESTS INTERCEPTED IN MAIL SHIPMENTS
For year ending April 30, 1921

Insect or Disease	Occurring on	From	Number of Shipments Infested
Aphids	Chrysanthemum	Georgia	1
Aphids	Chrysanthemum	North Carolina	1
Aphids	Spirea	Florida	1
Aspidiotus destructor Sign.	Coconut	Cuba	2
Aspidiotus destructor Sign.	Palm	Cuba	1
Aspidiotus orientalis Newst.	Coconut	Cuba	3

Insect or Disease	Occurring on	From	Number of Shipments Infested
Aspidiotus subsimilis var. *anonae* Houser	Unknown seed pod	Cuba	1
Aspidiotus subsimilis var. *anonae* Houser	Unknown plant	Cuba	1
Aspidistra scale	Fern	Georgia	1
Aspidistra scale	Sisal hemp	Cuba	1
Beetle	Seeds	Cuba	1
Beetle	Seeds	Venezuela	1
Beetle	Sweet potato	Florida	1
Bud insect injury	Nectarine	California	1
Black melanose	Citrus	Cuba	2
Black scale	Cotton	Cuba ?	1
Black scale	Oleander	Florida	1
Brown fungus	Common whitefly	Florida	2
Chaff scale	Citrus	Ohio	1
Cherry scale	Pear	Georgia	1
Citrus scab	Citrus	Cuba	2
Cloudy-winged white-fly	Citrus	Cuba	1
Coccus acuminatus (Sign.)	Fern ?	Cuba	1
Coccus acuminatus (Sign.)	Jasmine	Cuba	1
Coffee bean weevil	Sweet potato	Florida	1
Common mealy-bug	Canna	Florida	1
Common mealy-bug	Chrysanthemum	Georgia	1
Common whitefly	Cape jasmine	Florida	1
Common whitefly	Citrus	Florida	2
Common whitefly	Citrus	Georgia	1
Common whitefly	Citrus (leaf)	Florida	2
Common whitefly	Jasmine	Florida	2
Common whitefly	Jasmine	Unknown	1
Corn-ear worm	Indian corn	Cuba	2
Cottony cushion-scale	Rose	Florida	1
Cottony maple scale	Grape	Florida	1
Cucujid beetle	Coconut	Cuba	1
Dipteron	Lily plant (?)	Costa Rica	1
Dictyospermum scale	Limes	Dominica	1
Earthworm	Soil about plants	France	1
Earwig	Lily plants (?)	Costa Rica	1
English walnut scale	Plum	Florida	1
Euonymus scale	Japonica	Florida	1
Euonymus scale	Japonica	Georgia	1
Florida red scale	Citrus	Cuba	1
Florida red scale	Citrus	Florida	1
Fungus—*Monascus* sp.	Citrus	Greece	1
Fungus—*Trichosphaerica parasitica* R. Hartig ?	Unknown	Germany	1
Gloomy scale	Grape	Kentucky	1
Grape cane borer (?)	Grape	Florida	1
Greedy scale	Fig	Florida	1
Greenhouse whitefly	Chrysanthemum	North Carolina	1
Hemichionaspis sp.	Unknown plant	Cuba	1
Hemispherical scale	Fern (?)	Cuba	1
Hemispherical scale	Palm	Cuba	1
Ivy scale	Oleander	Florida	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Ivy scale	Palm	Cuba	1
Ivy scale	Palm	Florida	2
Latania scale	Grape	Florida	2
Latania scale	Palm	Florida	1
Latania scale	Rose	Unknown	1
Latania scale	Unknown plant	Cuba	1
Leaf blotch	Rose	Georgia	1
Leaf spots	Strawberry	New York	1
Lepidopterous egg (?)	Spanish bayonet	Florida	1
Lepidopterous larva	Guairena seed	Venezuela	1
Lepidopterous larvae	Strawberry	Georgia	1
Lepidopterous larvae	Tree seed pod	Cuba	1
Lesser snow scale	Cotton	Cuba ?	1
Long scale	Citrus	Florida	2
Long-tailed mealy bug	Oleander	Florida	1
Mealy bug	Cactus	Cuba	1
Mealy bug	Citrus	Cuba	1
Mealy bug	?	Cuba	2
Mining scale ?	?	Florida	1
Mite	Citrus	Florida	1
Mite	Croton	Cuba	1
Mite eggs	Holly	France	1
Mite egg cases	Mistletoe	France	1
Mold	Bulb	Pennsylvania	1
Moth	Lily plants	Costa Rica	1
Mulberry whitefly	Cut flower leaves	Georgia	1
Oyster-shell scale (?)	Fig	Florida	1
Palmetto scale	Palm	?	1
Parlatoria-like scale	Unknown herb	Florida	1
Parlatoria-like scale	Wild orchid	Florida	1
Peach yellows ?	Peach	Florida	1
Pseudaonidia paeoniae (Ckll.)	Japonica	Georgia	1
Purple scale	Citrus	Cuba	3
Purple scale	Citrus	Florida	3
Purple scale	Citrus	Isle of Pines	1
Purple scale	Citrus	Texas	1
Purple scale	Citrus leaf	Florida	2
Purple scale	Japonica	Georgia	1
Purple scale	Japonica (?)	Georgia	1
Purple scale	Limes	Dominica	1
Pustule scale	Fig	Florida	1
Pustule scale	Grape	Florida	1
Pustule scale	Oleander	Florida	5
Putnam's scale	Peach (?)	Michigan	1
Red Aschersonia	Common whitefly	Florida	1
Root knot	Fig	Florida	8
Root knot	Fig	Georgia	1
Root knot	Fig	Unknown	1
Root knot (?)	Mulberry	Unknown	1
Root knot	Peach	Florida	2
Root knot	Pecan	Florida	1
Root knot	Rose	Georgia	1
Root knot	Rose	Pennsylvania	2
Root knot	Unknown	Florida	2
Root knot	Unknown	Unknown	1
Rose scale	Rose	Florida	3
Rose scale	Rose	Georgia	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Rose scale	Raspberry	Michigan	1
Rot	Limes	Dominica	1
Rufous scale	Citrus	Cuba	1
Rufous scale	?	Florida	1
Rufous scale	?	Mexico	1
San Jose scale	Grape	Florida	1
San Jose scale	Nectarine	California	1
San Jose scale	Peach	Florida	1
San Jose scale	Pear	Georgia	1
San Jose scale	Plum	Florida	1
San Jose scale	Rose	Florida	1
Scale	Jasmine	Cuba	1
Scale	Sugar cane	Cuba	1
Scolytid beetle	Seeds	Cuba	2
Soft brown scale	Century plant	Unknown	1
Soft brown scale	Citrus	Cuba	1
Soft brown scale	Citrus	Florida	5
Soft brown scale	Japonica	Georgia	1
Soft brown scale	Jasmine	Florida	1
Soft brown scale (?)	Jasmine	Cuba	1
Soft scale	Unknown herb	Florida	1
Sowbug	Lily plants (?)	Costa Rica	1
Spider	Lily plants (?)	Costa Rica	1
Sweet potato weevil	Sweet potato	Cuba	1
Termites	Bulbs	Alabama	1
Thrips nymphs	Chrysanthemum	North Carolina	1
West Indian fruit fly	Guava	Isle of Pines	2
Whitefly	Guava (?)	Mexico	1
White peach scale	Pecan	Florida	1
White peach scale	Unknown	Cuba	1
Withertip	Citrus leaves	Missouri	1
Woolly whitefly	Citrus	Cuba	1

Quarantine Inspector's Summary for the Year Ending April 30, 1922

Ships and Vessels Inspected:

From foreign ports	2225	
From U. S. ports other than Florida	1338	
From Florida ports	616	
Total		4,179

Number of Parcels Inspected:

Arriving by water:

Passed	1,175,391½	
Treated and passed	140,988	
Returned to shipper	2,306	
Contraband destroyed	1,477½	
Total		1,320,163

Arriving by land: Express, freight, wagon, etc.:

Passed	14,780	
Treated and passed	245½	
Returned to shipper	206	
Contraband destroyed	250½	
Total		15,482

Arriving by mail:		
Passed	1,834½	
Treated and passed	94	
Returned to shipper	98	
Contraband destroyed	28½	
Total		2,055
GRAND TOTAL OF PARCELS INSPECTED		1,337,700
Number of parcels on hand pending determination as to final disposition		7

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Shipments by all means of transportation except parcel post
For year ending April 30, 1922

Insect or Disease	Occurring on	From	Number of Shipments Infested
Actinomyces scabies Kohn.	Potato	England	1
Actinomyces scabies Kohn.	Potato	Germany	32
Actinomyces scabies Kohn.	Potato	Norway	1
Actinomyces scabies Kohn.	Potato	Scotland	1
Actinomyces scabies Kohn.	Potato	Spain	1
Actinomyces scabies Kohn.	Potato	England	28
Actinomyces scabies Kohn.	Potato	Holland	4
Aleurothrixus howardi (Quaint.)	Citrus	Cuba	1
Anthracnose	Citrus	Cuba	1
Anthracnose	Orange	Spain	1
Anthracnose	Sapodilla	Cuba	1
Anthracnose	Sugar cane	Cuba	1
Aphids	Green beans	Nassau	1
Aphid nymph	Oleander	Florida	1
Argentine ant	Lettuce	Louisiana	1
Aspidiotus sp.	Chinaberry	Florida	1
Aspidiotus cyanophylli Sign. (scale)	?	Florida	1
Aspidiotus destructor Sign. (scale)	Avocado	Cuba	1
Aspidiotus destructor Sign. (scale)	Banana	Cuba	2
Aspidiotus destructor Sign. (scale)	Coconut	Cuba	11
Aspidiotus destructor Sign. (scale)	Palm	Cuba	1
Aspidiotus destructor Sign. (scale)	Guava	Cuba	1
Aspidiotus destructor Sign. (scale)	Oleander	Cuba	1
Aspidiotus destructor Sign. (scale)	Poinsettia	Florida	1
Aspidiotus destructor Sign. (scale)	Unknown	Cuba	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Aspidiotus destructor Sign. (scale)	Jamaica apple	Cuba	1
Aspidiotus orientalis Newst. (scale)	*Asparagus sprengeri*	Florida	1
Aspidiotus orientalis Newst. (scale)	Coconut husk	Cuba	18
Aspidiotus orientalis Newst. (scale)	Rose	Florida	1
Aspidiotus orientalis Newst. (scale)	Royal palm	Cuba	1
Aspidiotus orientalis Newst. (scale)	Royal palm seed	Cuba	1
Aspidiotus subsimilis var. *anonae* Houser	Cuttings	Cuba	1
Aspidiotus subsimilis var. *anonae* Houser	Plum	Florida	1
Aspidiotus subsimilis var. *anonae* Houser	Jamaica apple	Cuba	1
Asterolecanium sp.	Air plant	Nassau	1
Asterolecanium miliaris longum Green	Bamboo	Cuba	1
Bamboo scale	?	Florida	1
Beetle (*Carpophilus* sp.)	Chinese date	Texas	1
Beetle work	Sugar cane	Cuba	1
Blackfly (*Aleurocanthus woglumi* Ashby)	Avocado	Cuba	1
Blackfly (*Aleurocanthus woglumi* Ashby)	Citrus	Cuba	5
Blackfly (*Aleurocanthus woglumi* Ashby)	Bay	Nassau	1
Blackfly (*Aleurocanthus woglumi* Ashby)	Spice	Nassau	1
Blackfly (*Aleurocanthus woglumi* Ashby)	Jasmine	Cuba	1
Blackfly (*Aleurocanthus woglumi* Ashby)	Sapodilla	Nassau	1
Blackberry root gall	Blackberry	Illinois	1
Black melanose	Citrus	Cuba	2
Black melanose	Citrus	Isle of Pines	1
Black scale	Avocado	California	1
Black scale	Soursop	Cuba	1
Black scale	Mango	Cuba	1
Black scale	Pumpkin	Cuba	1
Black scale	Unknown	Cuba	1
Black scale	Citrus	Isle of Pines	1
Black scale	Cotton	Nassau	1
Black scale	Flower cluster	Cuba	1
Black scale	Oleander	Florida	3
Black scale	Poinsettia	Florida	1
Black scale	Sapodilla	Nassau	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Blue green citrus beetle	Pineapple	Cuba	1
Blue mold	Orange	Spain	1
Blue mold	Orchid	British W. Indies	1
Boisduval's scale	Coconut husk	Cuba	6
Boisduval's scale	Spanish lime	Cuba	1
Boisduval's scale	Orchid	New York	1
Borer injury	Sugar cane	Cuba	1
Botrytes sp.	Potato	Peru	1
California red scale	Orange leaf	California	1
Camellia scale (*Lepidosaphes camelliae*)	*Camellia japonica*	Georgia	1
Camellia scale (*Lepidosaphes camelliae*)	*Camellia japonica*	South Carolina	1
Cardin's whitefly	Guava	Florida	1
Ceroplastes sp.	Unknown	Cuba	1
Chaff scale	Citrus	Cuba	1
Chaff scale	Citrus	Isle of Pines	1
Chaff scale	Croton	Ohio	1
Chaff scale	Citrus	Unknown	1
Chaff scale	Orange	Germany	1
Chaff scale	Tieze	Cuba	1
Chaff scale	Orange	Spain	1
Chaff scale	Croton	Pennsylvania	1
Chaff scale	Orange	France	1
Chalcid	Chiromoya	Cuba	1
Cherry scale	Plum	Kentucky	1
Cherry scale	Plum	South Carolina	1
Cherry scale	Unknown	Kentucky	1
Chrysomphalus mimosae Comst.	Plum	Florida	1
Chrysomphalus sp.	Unknown	Nassau	1
Citrus scab	Citrus	Alabama	1
Cloudy-winged whitefly	Citrus	Florida	1
Cloudy-winged whitefly	Citrus	Cuba	1
Coccinellid	Banana	Jamaica	1
Coccus acuminatus	Mango	Florida	1
Coccus hesperidum	Rose	Florida	1
Coccus hesperidum	Unknown	Cuba	1
Coconut mealy-bug	Sugar apple	Cuba	1
Coconut mealy-bug	Soursop	Nassau	1
Common mealy-bug	Coconut	Cuba	1
Common mealy-bug	Croton	Florida	1
Common mealy-bug	Croton	Ohio	1
Common mealy-bug	Croton	Pennsylvania	1
Common mealy-bug	Fig	South Carolina	1
Common mealy-bug	Geranium	Tennessee	1
Common mealy-bug	Oleander	Florida	1
Common mealy-bug	Coleus	North Carolina	1
Common whitefly	Hedge plant	South Carolina	1
Common whitefly	Citrus	Florida	11
Common whitefly	Jasmine	Florida	1
Common whitefly	Jasmine	Georgia	7
Common whitefly	Jasmine	South Carolina	1
Common whitefly	Unknown	Arkansas	1
Common whitefly	Unknown	South Carolina	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Common whitefly	California privet	Florida	2
Common whitefly	Jasmine	Louisiana	1
Common whitefly	Jasmine	South Carolina	1
Common whitefly	Jasmine	Florida	1
Conchaspis angraeci Ckll.	Croton	Florida	1
Corn ear worm	Corn	Nassau	2
Cottony cochineal scale	Cactus	Cuba	1
Cottony cushion-scale	Rose	Florida	2
Cottony cushion-scale	Rose	Florida	2
Cottony cushion-scale	Croton	Florida	1
Cyanophyllum scale	Loquat	South Carolina	1
Cyanophyllum scale	Palm	Florida	1
Crown gall	Rose	Florida	1
Crown gall	Rose	Kentucky	1
Crown gall	Rose	Minnesota	1
Crown gall	Rose	Missouri	1
Crown gall	Rose	New Jersey	1
Crown gall	Rose	Pennsylvania	1
Crown gall	Rose	Illinois	1
Crown gall	Rose	Georgia	1
Diatraea sp.	Sugar cane	Cuba	1
Dictyospermum scale	Coconut	Honduras	1
Dictyospermum scale	Crape myrtle	Georgia	1
Dictyospermum scale	Lime	Dominica	1
Dictyospermum scale	Mango	Florida	1
Dictyospermum scale	Orange	Spain	1
Dictyospermum scale	Unknown	Cuba	1
Dictyospermum scale	Cinnamon leaves	Panama	1
Dictyospermum scale	Citrus	Florida	1
Dictyospermum scale	Coconut	Cuba	1
Dictyospermum scale	Orange	France	1
Diplodia sp.	Lime	Dominica	1
Diplodia sp.	Coconut palm	Cuba	1
Dipteron	Weed	Portugal	1
Dipterous pupa	Unknown	Cuba	1
Egg puncture	Sycamore	Tennessee	1
English walnut scale	Coconut	Cuba	1
English walnut scale	Peach	Georgia	1
English walnut scale	Pear	Florida	1
Fern scale	Dracena	Holland	1
Fern scale	Fern	New York	1
Fern scale	Pandanus	Cuba	1
Fiorinia theae Green	Japonica	Florida	1
Fiorinia theae Green	Unknown	South Carolina	1
Florida red scale	Oleander	Florida	1
Florida red scale	Avocado	Cuba	2
Florida red scale	Citrus	Cuba	1
Florida red scale	Rose	Florida	2
Florida red scale	Rose	Florida	1
Florida red scale	Banana leaf	Jamaica	1
Florida red scale	Citrus	Cuba	1
Florida red scale	Citrus	Nassau	1
Florida red scale	Pandanus	Cuba	1
Florida red scale	Rose	Nassau	1
Florida whitefly	Guava	Florida	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Fly (Fam. *Drosophilidae)*	Guava	Cuba	1
Frankliniella cephalica masoni Watson	Unknown	Cuba	1
Fungus (*Diplodia* sp.)	Cocoa bean	British W. Indies	1
Fungus	Unknown plant	Cuba	1
Fungus	Potato	Germany	1
Fungus (*Fusarium* sp.)	Corn	Nassau	1
Fungus (Myxomycetes)	Unknown vine	Georgia	1
Gall	Blackberry	Kentucky	1
Grape scale	Peach	Georgia	1
Greedy scale	Bay	Florida	1
Greedy scale	Unknown	Georgia	1
Greedy scale	Grapefruit	Mexico	1
Greedy scale	Pear	Spain	1
Greenhouse thrips	Citrus	Cuba	1
Greenhouse thrips	Croton	Cuba	1
Greenhouse orthezia	Rose	Nassau	1
Haplothrips merrilli	Coconut husk	Cuba	5
Hemichionaspis sp.	Bobug	Isle of Pines	1
Hemichionaspis sp.	Royal poinciana	Cuba	1
Hemipteron eggs	Tree	New York	1
Hemispherical scale	Jasmine	Cuba	1
Hemispherical scale	Lily	Florida	1
Hemispherical scale	Fern	Cuba	1
Hemispherical scale	Fern	Florida	1
Hemispherical scale	Soursop	Cuba	2
Hemispherical scale	Palm	Nassau	1
Hemispherical scale	Unknown	Florida	1
Hemispherical scale	Unknown	Cuba	1
Ivy scale	Crape myrtle	Georgia	1
Ivy scale	Oleander	Ohio	1
Ivy scale	Palm	New York	1
Ivy scale	Palm	Florida	2
Ivy scale	Palm	Nassau	1
Ivy scale	Palm	California	1
Ivy scale	Chinaberry	Florida	2
Ivy scale	Chinaberry	Texas	1
Ivy scale	Ivy	Florida	1
Juniper scale	Palm	California	1
Latania scale	Unknown tree	Florida	1
Latania scale	Unknown tree	Cuba	1
Latania scale	Banana	Unknown	1
Latania scale	Begonia	Florida	1
Latania scale	Coconut	Africa	1
Latania scale	Unknown cutting	Cuba	1
Latania scale	Fig	Georgia	1
Latania scale	Fig	Mississippi	1
Latania scale	Orange	Ecuador	1
Latania scale	Palm	Georgia	1
Latania scale	Palm	Cuba	1
Latania scale	Rose	Florida	1
Latania scale	Rose	Nassau	1
Latania scale	Rose	South Carolina	1
Latania scale	Soursop	Nassau	1
Latania scale	Unknown	Cuba	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Latania scale	Unknown	Florida	1
Latania scale	Guava	Florida	1
Latania scale	Guava	Cuba	1
Lepidoptera	Unknown	Vermont	1
Lepidopterous larva	Strawberry	South Carolina	1
Lepidopterous larva	Tree seed pod	Cuba	1
Lepidopterous larva	Apricot (?)	New York	1
Lepidopterous pupa case	Unknown tree	Cuba	1
Lepidopterous pupa case	Cut flower	England	1
Lepidopterous pupa case	Citrus	Cuba	1
Lepidosaphes sp.	Lilac	Massachusetts	1
Lepidosaphes hawaiiensis (Mask.)	Soursop	Cuba	1
Lepidosaphes hawaiiensis (Mask.)	?	Africa	1
Lesser snow scale	Cotton boll	Cuba	1
Lesser snow scale	Coconut	Cuba	3
Lesser snow scale	Hibiscus	Florida	2
Lesser snow scale	Soursop	Cuba	1
Lesser snow scale	Oleander	Florida	1
Lesser snow scale	Palm	Nassau	1
Lesser snow scale	Sapodilla	Nassau	1
Lesser snow scale	Soursop	Cuba	1
Lesser snow scale	Mesembryanthemum	Florida	1
Lesser snow scale	*Pilea* sp.	Florida	1
Lesser snow scale	Palm	Cuba	1
Lesser snow scale	Unknown	Africa	1
Long scale	Citrus	Spain	1
Long scale	Citrus	Foreign	1
Long scale	Citrus	Florida	1
Long scale	Citrus	Cuba	1
Long scale	Orange	Florida	1
Long scale	Orange	Germany	1
Long-tailed mealy-bug	Croton	Cuba	1
Mealy-bug	Unknown	Bermuda	1
Mealy-bug	Banana	Cuba	1
Mealy-bug	Croton	Florida	2
Mealy-bug	Croton	Florida	1
Mealy-bug	Croton	South Carolina	1
Mealy-bug	Cotton boll	Cuba	1
Mealy-bug	Unknown	Cuba	3
Mealy-bug	Unknown	Bermuda	1
Mealy-bug	Sugar cane	Cuba	1
Miner work	Orchids	West Indies	1
Mining scale	Jasmine	Cuba	1
Mining scale	Sapodilla	Cuba	1
Mining scale	Sapodilla	Nassau	3
Mining scale	Unknown	Cuba	1
Mite	Unknown	Florida	1
Moth borer	Corn	Nassau	1
Moth borer	Sugar cane	Cuba	14
Mulberry whitefly	Bay	Florida	1
Oyster-shell scale	Apple (fruit)	England	1
Oyster-shell scale	Birch hoops	Massachusetts	1
Oyster-shell scale	Fig	South Carolina	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Oyster-shell scale	Lilac	Virginia	1
Oyster-shell scale	Lilac	Illinois	1
Oyster-shell scale	Lilac	Michigan	1
Oyster-shell scale	Lilac	Pennsylvania	1
Oyster-shell scale	Lilac	North Carolina	1
Oyster-shell scale	Unknown tree	New York	1
Palmetto scale	Palm	Florida	1
Pineapple mealy-bug	Pineapple	Hawaii	1
Pineapple scale	Pineapple	Hawaii	1
Pine leaf scale	Spruce	Massachusetts	1
Pseudischnaspis alienus (Newst.)	Unknown	Cuba	2
Pseudischnaspis alienus (Newst.)	Unknown	Mexico	1
Pseudaonidia articulatus (Morg.)	Banana	Cuba	1
Pseudaonidia articulatus (Morg.)	Citrus	Cuba	4
Pseudaonidia articulatus (Morg.)	Citrus	Jamaica	1
Pseudaonidia articulatus (Morg.)	Jamaica apple	Cuba	1
Pseudaonidia articulatus (Morg.)	Rose	Cuba	1
Pseudaonidia articulatus (Morg.)	Spice	Nassau	1
Pseudaonidia articulatus (Morg.)	Tamarind	Nassau	3
Pseudaonidia articulatus (Morg.)	Tiesa	Cuba	1
Pseudaonidia articulatus (Morg.)	Acalypha	Cuba	1
Pseudaonidia articulatus (Morg.)	Citrus	Nassau	1
Pseudaonidia articulatus (Morg.)	Coffee	Panama	1
Pseudaonidia articulatus (Morg.)	Croton	Cuba	1
Pseudaonidia articulatus (Morg.)	Grapefruit	Mexico	1
Pseudaonidia articulatus (Morg.)	Oleander	Florida	1
Pseudaonidia articulatus (Morg.)	Rose	Florida	2
Pseudaonidia articulatus (Morg.)	Rose	Nassau	1
Pseudaonidia articulatus (Morg.)	Screw pine	Cuba	1
Pseudaonidia articulatus (Morg.)	Spice leaves	Nassau	1
Pseudaonidia articulatus (Morg.)	Unknown	Cuba	1
Pomace fly	Mango fruit	Cuba	1
Purple scale	Citrus	Cuba	20
Purple scale	Citrus	Florida	10
Purple scale	Citrus	Isle of Pines	8
Purple scale	Citrus	Jamaica	1
Purple scale	Citrus	Germany	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Purple scale	Orange	Africa	1
Purple scale	Orange	Louisiana	1
Purple scale	Orange	Nassau	1
Purple scale	Orange	Germany	1
Purple scale	Lime	Nassau	1
Purple scale	Lime	Dominica	1
Purple scale	Tangerine	Africa	1
Pustule scale	Unknown cutting	Cuba	1
Pustule scale	Oleander	Florida	7
Pustule scale	Stephanotus	Florida	1
Pustule scale	Unknown tree	Cuba	1
Putnam's scale	Apricot (?)	New York	1
Putnam's scale	Chestnut	North Carolina	1
Putnam's scale	Unknown	Illinois	1
Pyriform scale	Guava	Florida	1
Pyriform scale	Guava	Florida	1
Pyriform scale	Jasmine	Florida	1
Red spider	Cherry laurel	Florida	1
Rice weevil	Pigeon pea	Nassau	1
Root knot	Fig	Alabama	1
Root knot	Fig	Arkansas	1
Root knot	Fig	Florida	20
Root knot	Fig	Georgia	13
Root knot	Fig	Mississippi	2
Root knot	Fig	North Carolina	1
Root knot	Fig	South Carolina	10
Root knot	Fig	Texas	1
Root knot	Mulberry	Georgia	1
Root knot	Peach	Florida	5
Root knot	Peach	Georgia	8
Root knot	Peach	North Carolina	2
Root knot	Peach	South Carolina	6
Root knot	Rose	Florida	1
Root knot	Unknown	Georgia	1
Rose scale	Blackberry	Illinois	1
Rose scale	Blackberry	Florida	1
Rose scale	Blackberry	Kentucky	2
Rose scale	Blackberry	North Carolina	1
Rose scale	Blackberry	South Carolina	2
Rose scale	Rose	Georgia	1
Rose scale	Rose	South Carolina	2
Rose scale	Rose	Ohio	1
Rose scale	Rose	Unknown	1
San Jose scale	Apple	Kentucky	1
San Jose scale	Apple	South Carolina	3
San Jose scale	Apricot (?)	Kentucky	1
San Jose scale	Cherry	Virginia	1
San Jose scale	Currant	Indiana	1
San Jose scale	Fig	Georgia	3
San Jose scale	Fig	Mississippi	1
San Jose scale	Fig	South Carolina	1
San Jose scale	Grape	Georgia	1
San Jose scale	Grape	Illinois	1
San Jose scale	Grape	Kentucky	1
San Jose scale	Lilac	Virginia	1
San Jose scale	Peach	Alabama	1
San Jose scale	Peach	Florida	4
San Jose scale	Peach	Georgia	6

Insect or Disease	Occurring on	From	Number of Shipments Infested
San Jose scale	Peach	Kentucky	1
San Jose scale	Peach	North Carolina	2
San Jose scale	Peach	South Carolina	5
San Jose scale	Peach	Virginia	1
San Jose scale	Peach	West Virginia	1
San Jose scale	Pear	Florida	3
San Jose scale	Plum	Florida	2
San Jose scale	Plum	Georgia	3
San Jose scale	Plum	South Carolina	2
San Jose scale	Plum	West Virginia	1
San Jose scale	Poplar	Georgia	1
San Jose scale	Rose	Florida	1
San Jose scale	Rose	South Carolina	1
San Jose scale	Unknown	South Carolina	1
San Jose scale	Unknown	New York	1
San Jose scale	Walnut	Florida	1
Scolytid beetle	Seeds	Cuba	1
Scolytid beetle	Mahogany logs	Nicaragua	1
Scolytid beetle injury	Bobug tree	Cuba	2
Scurfy scale	Birch	Maine	2
Scurfy scale	*Ribes* sp.	Iowa	1
Snow scale	Citrus	Cuba	1
Snow scale	Citrus	Jamaica	1
Soft brown scale	Citrus	Cuba	5
Soft brown scale	Citrus	Florida	1
Soft brown scale	Citrus	Jamaica	1
Soft brown scale	Ivy	Virginia	1
Soft brown scale	Jasmine	Cuba	1
Soft brown scale	Poinsettia	Cuba	1
Soft brown scale	Sapodilla	Nassau	1
Soft brown scale	Unknown	Florida	1
Strawberry crown-borer	Strawberry	Arkansas	4
Strawberry crown-borer	Strawberry	Georgia	1
Sugar cane moth borer	Sugar cane	Cuba	1
Sugar cane mealy-bug	Sugar cane	Cuba	2
Sweet potato weevil	Sweet potato	Florida	1
Sweet potato weevil	Sweet potato	Mexico	1
Sweet potato weevil	Sweet potato	Nassau	2
Sweet potato weevil	Sweet potato	Texas	1
Targionia sacchari (Ckll.)	Sugar cane	British W. Indies	10
Targionia sacchari (Ckll.)	Sugar cane	Cuba	2
Targionia sacchari (Ckll.)	Sugar cane	Nassau	1
Tessellated scale	Star apple	Nassau	1
Uredo sp. (Rust)	Unknown	Florida	1
West Indian fruit fly	Mango	Cuba	1
West Indian fruit fly	Cuban plum	Cuba	1
White peach scale	Peach	Florida	1
White peach scale	Plum	Florida	1
White peach scale	Plum	South Carolina	1
White peach scale	Unknown	Florida	1
Whitefly	Azalea (?)	Germany	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Whitefly	Guava	Mexico	1
Whitefly	Jasmine	Florida	1
Whitefly	Jasmine	Texas	1
Whitefly	Jasmine	Unknown	1
Withertip	Citrus	Alabama	1
Woolly apple aphis	Apple	Georgia	1
Woolly apple aphis	Apple	South Carolina	1
Woolly apple aphis	Apple	West Virginia	1
Woolly whitefly	Citrus	Cuba	4
Yam scale	Yam	Grand Cayman	1
Ziziphus scale	Citrus	Foreign	1
Ziziphus scale	Orange	Spain	1
Ziziphus scale	Tangerine	Africa	1

Pests Intercepted in Mail Shipments
For year ending April 30, 1922

Insect or Disease	Occurring on	From	Number of Shipments Infested
Aspidiotus destructor Sign.	Coconut	Cuba	4
Aspidiotus destructor Sign.	Guava	Cuba	1
Aspidiotus orientalis Newst.	Coconut	Cuba	2
Aspidiotus subsimilis var. *anonae* Houser	Unknown cuttings	Cuba	1
Aspidiotus spinosus Comst.	Unknown	Florida	1
Beetle	Palm seed	Java	1
Beetle—*Catorama* sp.	Gourd	Mexico	1
Blackfly	Citrus	Cuba	1
Black melanose	Citrus	Cuba	3
Black melanose	Citrus	Isle of Pines	1
Black melanose	Unknown	Cuba	1
Black scale	Soursop	Cuba	1
Blue mold	Orchid	Dutch W. Indies	1
Boisduval's scale	Coconut	Cuba	1
Boisduval's scale	Corojo palm	Cuba	1
Boisduval's scale	Spanish lime	Cuba	1
California red scale	Lemon	Jerusalem ?	1
Camellia scale	Unknown	Georgia	1
Cardin's whitefly	Guava	Cuba	1
Caterpillar	Unknown tree seed	Venezuela	1
Centipede	Moss	Ireland	1
Chaff scale	Citrus	Foreign	1
Chaff scale	Limes	Mexico	1
Cigarette beetle	Nutmeg	Seychelles, Indian Ocean	1
Cladosporium citri Massee	Citrus	Cuba	1
Cloudy-winged white-fly	Citrus	Bermuda	1
Cloudy-winged white-fly	Citrus	Cuba	2
Coconut mealy-bug	Guava	Cuba	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Common mealy-bug	Coleus	Iowa	1
Common mealy-bug	Coleus	Pennsylvania	1
Common whitefly	Citrus	Florida	3
Common whitefly	Jasmine	Florida	1
Crown gall	Rose	Iowa	1
Crown gall	Rose	Pennsylvania	3
Dictyospermum scale	Caladium	Cuba	1
Dictyospermum scale	Oleander	Florida	1
Dictyospermum scale	Palm	Pennsylvania	1
Florida red scale	Citrus	Cuba	3
Fungus—*Diplodia* sp.	Palm seed	Java	1
Greedy scale	Bay	Florida	1
Greenhouse thrips	Citrus	Cuba	1
Hemispherical scale	Fern	Florida	2
Hemispherical scale	Soursop	Cuba	1
Imported cabbage worm	Cabbage	Georgia	1
Ivy scale	Oleander	Florida	2
Ivy scale	Oleander	Ohio	1
Ivy scale	Palm	Florida	1
Ivy scale	Palm	Pennsylvania	1
Ivy scale (?)	Rhododendron	North Carolina	1
Ivy scale	Unknown	Florida	1
Latania scale	Caladium	Cuba	1
Latania scale	Fig	Georgia	1
Latania scale	Unknown cutting	Cuba	1
Lepidopteron	Cut flowers	England	1
Lepidopterous larva	Citrus	Cuba	1
Lepidopterous pupa	Unknown	England	1
Lesser snow scale	Coconut	Cuba	1
Long scale	Citrus	Foreign	1
Long scale	Limes	Mexico	1
Long scale	Orange (peel)	Spain	1
Long-tailed mealy-bug	Caladium	Cuba	1
Long-tailed mealy-bug	Canna	Cuba	1
Long-tailed mealy-bug	Croton	Cuba	1
Long-tailed mealy-bug	Unknown	Cuba	1
Mealy-bug	Cotton bolls	Cuba	1
Mealy-bug	Unknown	Cuba	1
Melon aphis	Cotton	Cuba	1
Miner work	Orchid	Dutch W. Indies	1
Mining scale	Unknown	Florida	1
Mite	English walnut	Cuba	1
Mulberry whitefly	Bay	Florida	1
Oyster-shell scale	Apple (fruit)	England	1
Oyster-shell scale	Lilac (?)	Illinois	1
Purple scale	Citrus	Bermuda	1
Purple scale	Citrus	Cuba	8
Purple scale	Citrus	Florida	1
Purple scale	Citrus	Isle of Pines	3
Pustule scale	Oleander	Florida	1
Pustule scale	Unknown cutting	Cuba	1
Pyralid, *Plodia* sp.	Mango seed	India	2
Pyriform scale	Cinnamon	Windward Island (?)	1
Pyriform scale	Jasmine	Florida	1
Pyriform scale	Unknown	Florida	1
Red-banded thrips	Guava	Cuba	1

Insect or Disease	Occurring on	From	Number of Shipments Number of
Red spider	Cherry laurel	Florida	1
Root knot	Fig	Florida	9
Root knot	Fig	Georgia	4
Root knot	Fig	Illinois	1
Root knot	Fig	North Carolina	1
Root knot	Peach	Florida	2
Root knot	Peach	Georgia	1
Root knot	Peach	Unknown	1
Root knot	Rose	Florida	1
Root knot	Rose	Pennsylvania	3
Rose scale	Rose	Connecticut	1
Rose scale	Rose	Unknown	1
Rufous scale	Citrus	Cuba	1
Rufous scale	Limes	Mexico	1
Rufous scale	Unknown legumes	Cuba	1
San Jose scale	Currant	Indiana	1
San Jose scale	Fig	Georgia	1
San Jose scale	Peach	Florida	1
San Jose scale	Peach	Unknown	1
San Jose scale	Poplar	Georgia	1
San Jose scale	Unknown	New York	1
Snow scale	Citrus	Cuba	1
Soft brown scale	Citrus	Cuba	2
Soft brown scale	Citrus	Italy	1
Soft brown scale	Ivy	Virginia	1
Soft brown scale	Poinsettia	Cuba	1
Spring-tail	Canna	Cuba	1
Sugar cane mealy-bug	Sugar cane	Cuba	1
Targionia sacchari (Ckll.)	Sugar cane	Cuba	2
Wax scale	Citrus	Cuba	1
Weevil	Rhododendron	North Carolina	1
Whitefly	Azalea (?)	Germany	1
Woolly whitefly	Citrus	Cuba	3
Ziziphus scale	Citrus	Foreign	1

Quarantine Inspector's Summary for the Fourteen Months Ending June 30, 1922

Ships and Vessels Inspected:

From foreign ports	2583	
From U. S. ports other than Florida	1568	
From Florida ports	720	
Total		4,871

Number of Parcels Inspected:

Arriving by water:

Passed	1,923,363	
Treated and passed	156,839	
Returned to shipper	2,507	
Contraband destroyed	1,789	
Total		2,084,498

Arriving by land: Express, freight, wagon, etc.:

Passed	17,227	
Treated and passed	2,681½	
Returned to shipper	224	
Contraband destroyed	261½	
Total		20,394

Arriving by mail:		
Passed	2,080½	
Treated and passed	106	
Returned to shipper	117	
Contraband destroyed	32½	
Total		2,336
GRAND TOTAL OF PARCELS INSPECTED		2,107,228

Number of parcels on hand pending determination as to final disposition ... 7

BEE DISEASE ERADICATION

There is presented herewith a tabulation showing the amount of inspection work done during the period from May 1, 1920 to June 30, 1922. During this period 69 cases of American foul brood were located. These were distributed by counties as follows:

	Apiaries	Colonies Infected
Franklin	1	3
Hillsboro	4	12
Manatee	1	1
Palm Beach	7	21
Pinellas	23	27
Volusia	3	5
	39	69

BEE DISEASE ERADICATION

Report on Inspection and Eradication Work for the Period from May 1, 1920 to June 30, 1922

Number of apiaries inspected	1,353
Number of apiaries infected with American foul brood	39
Number of colonies inspected	34,602
Number of colonies infected with American foul brood	69
Number of apiaries infected with European foul brood	5
Number of colonies infected with European foul brood	5

PUBLICATIONS

The Board has continued to issue certain publications for the information of the public. Circulars containing the rules and regulations of the Board are issued from time to time. "Quarantine Notices" for the special information of transportation companies and of shippers are published and distributed. The Quarterly Bulletin of the State Plant Board has appeared regularly each quarter and has served a useful purpose in disseminating knowledge regarding plant pests and their control, as well as information as to the activities of the Board.

EMPLOYEES

Following is a list of employees of the Board as of June 30, 1922:

List of Employees, June 30, 1922

State Plant Board

J. T. Diamond........*Secretary*
J. G. Kellum........*Auditor*

Plant Commissioner's Office

Wilmon Newell........*Plant Commissioner*
Miss Lena R. Hunter........*Chief Clerk*
Miss Elita Lovejoy........*Stenographer*
Miss Eva C. Means........*Filing Clerk*
Henry Lloyd (Col.)........*Janitor*

Bee Disease Eradication

J. C. Goodwin........*Apiary Inspector*
C. F. Glenn........*District Apiary Inspector*
J. P. Anthony........*District Apiary Inspector*
W. H. Henderson........*District Apiary Inspector*
C. M. Biorseth........*District Apiary Inspector*
Chas. Mack........*District Apiary Inspector*
J. B. Nordmann........*District Apiary Inspector*
D. W. Abbott........*Assistant Apiary Inspector*
Fred Anthony........*Assistant Apiary Inspector*

Cane Disease Survey

C. P. Sheffield........*Inspector*

Department of Entomology

E. W. Berger........*Entomologist*
G. B. Merrill........*Associate Entomologist*
Geo. D. Smith........*Associate Entomologist*
Mrs. H. M. Williams........*Stenographer*

Quarantine Department

J. H. Montgomery........*Quarantine Inspector*
A. C. Brown........*Assistant Quarantine Inspector*
U. C. Zeluff........*Assistant Quarantine Inspector*
R. A. Knight........*Assistant Quarantine Inspector*
R. D. Potter........*Assistant Quarantine Inspector*
Harold Mowry........*Assistant Quarantine Inspector*
L. R. Warner........*Assistant Quarantine Inspector*
Wm. V. Millington........*Assistant Quarantine Inspector*
M. R. Brown........*Assistant Quarantine Inspector*
J. V. Gist........*Assistant Quarantine Inspector*
Paul Thomas........*Assistant Quarantine Inspector*
W. N. Hull........*Deputy Inspector*

Sweet Potato Weevil Eradication

S. H. Rountree........*Inspector*
W. M. Prevatt........*Inspector*

Nursery Inspection Department

F. M. O'Byrne........ *Nursery Inspector*
J. Chaffin .... *Assistant Nursery Inspector*
Chas. M. Hunt........ *Assistant Nursery Inspector*
P. F. Robertson........ *Assistant Nursery Inspector*
H. W. Fogg........ *Assistant Nursery Inspector*
C. A. Bass........ *Assistant Nursery Inspector*
Jas. Kerr .... *Assistant Nursery Inspector*
Geo. H. Baker........ *Assistant Nursery Inspector*
J. F. Marsh........ *Assistant Nursery Inspector*
John R. Springer........ *Assistant Nursery Inspector*
Emory L. Kelly........ *Assistant Nursery Inspector*
Archie R. Oakley........ *Inspector*
O. T. Stone........ *Invoice Clerk*
Miss L. McIlvaine........ *Stenographer*
Miss Janette Roux........ *Stenographer*
Mrs. Genevieve E. White........ *Stenographer*

Canker Eradication Department

Frank Stirling........ *General Inspector*
Miss Rena Murrill .... *Stenographer*

Assistant District Inspectors

H. D. Bollinger
S. L. McClanahan
H. C. Artis

Inspectors

Arthur Adams
B. F. Adams
D. W. Barber
J. B. Bowers
Chas. M. Brown
Ollie D. Brown
G. F. Burden
H. G. Carter
R. A. Cash
N. L. Chambers
D. S. Conner
H. J. Dillingham
Z. V. Dyson
W. F. Eberhardt
H. D. Eikenberry
Jno. Eiland
Robt. E. Fish
Ed Frierson
H. H. Frierson
Fritz Fuchs
Harvey Gossman
Don Grace
Clayton E. Hall
Sam P. Harn
Reginald Hart
J. Harvey Henderson
R. C. Henderson
A. S. Hooker
Geo. Janes
J. S. Lange
J. L. Lazonby
Merton LeRoy
R. W. Lindner
C. T. Link
Wm. D. Mahan
J. C. Mendel
H. C. Parham
Bradley Park
T. R. Robinson
M. W. Rubison
Henry Schumacher
J. S. Sherman
I. M. Shriner
Cleve F. Smith
H. D. Smith
Lonnie S. Smith
Charlie S. Stephens
R. D. Stevenson
Chas. Stitts
Clifton R. Stokes
G. E. Tedder
W. M. Tillman
H. L. Ulmer
J. E. Ulmer

FINANCIAL REPORT

For Fiscal Year Ending April 30, 1921

(Date omitted)

To the State Plant Board:

Gentlemen: I herewith submit the following report of the finances of the Board for the period beginning May 1, 1920 and ending April 30, 1921:

SUMMARY

Resources

General Fund	$ 35,000.00	
Citrus Canker Eradication	76,290.05	
Nursery Inspection	30,334.42	
Quarantine Inspection	33,346.48	
Sweet Potato Weevil Eradication	14,683.27	
Bee Disease Eradication	7,147.78	
Incidental Fund	7,928.72	$204,730.72

Expenditures

General Fund	$ 34,999.97	
Citrus Canker Eradication	60,586.08	
Nursery Inspection	22,666.31	
Quarantine Inspection	26,191.71	
Sweet Potato Weevil Eradication (Includes $515.51 for Mosaic)	10,955.38	
Bee Disease Eradication	5,674.68	
Incidental Fund	3,291.86	$164,365.99
Balance from the General Fund to revert to the State	.03	
Balance Special Funds carried forward May 1, 1921	$ 40,364.70	$ 40,364.73

ITEMIZED EXPENDITURES BY FUNDS

GENERAL FUND

Resources

Appropriation Available May 1, 1920 $ 35,000.00

Expenditures

For Salaries	$ 18,622.61	
For Office Expenses	6,176.65	
For Traveling Expenses	5,808.52	
For Printing	2,829.45	
For General Supplies	552.07	
For Miscellaneous Expenses	1,010.67	$34,999.97*
Balance Reverting to the State May 1, 1921		$ .03

*The disbursement of the General Fund for the fiscal year ending April 30, 1921, classified by departments rather than by items, was as follows:

Plant Board, expenses	$ 1,194.40
Secretary's Office (Tallahassee)	1,349.79
General Expenses	17,149.87
Department of Entomology	6,967.00
Banana Root Borer	295.00
Mosaic Eradication	402.77
Nursery Department	5,331.93
Sweet Potato Weevil Eradication	649.93
Quarantine Department	657.68
Citrus Canker Eradication	1,001.60
Unexpended Balance Reverting to State	.03
Total	$35,000.00

—Plant Commissioner.

Citrus Canker Eradication

Resources

Unexpended Balance Brought Forward May 1, 1920		$ 46,290.05
Appropriation Available July 1, 1920		30,000.00
		$ 76,290.05

Expenditures

For Salaries	$ 42,613.05	
For Office Expenses	466.51	
For Traveling Expenses	16,220.37	
For General Supplies	634.34	
For Miscellaneous Expenses	651.81	$ 60,586.08
Balance Carried Forward May 1, 1921		$ 15,703.97

Nursery Inspection

Resources

Balance Brought Forward May 1, 1920		$ 10,334.42
Appropriation Available July 1, 1920		20,000.00
		$ 30,334.42

Expenditures

For Salaries	$ 8,871.94	
For Office Expenses	704.22	
For Traveling Expenses	12,880.69	
For General Supplies	138.51	
For Miscellaneous Expenses	70.95	$ 22,666.31
Balance Carried Forward May 1, 1921		$ 7,668.11

Quarantine Inspection

Resources

Balance Brought Forward May 1, 1920		$ 8,346.48
Appropriation Available July 1, 1920		25,000.00
		$33,346.48

Expenditures

For Salaries	$ 19,044.29	
For Office Expenses	536.41	
For Traveling Expenses	5,702.38	
For General Supplies	137.82	
For Miscellaneous Expenses	770.81	$ 26,191.71
Balance Carried Forward May 1, 1921		$ 7,154.77

Sweet Potato Weevil Eradication

Resources

Balance Brought Forward May 1, 1920		$ 4,683.27
Appropriation Available July 1, 1920		10,000.00
		$ 14,683.27

Expenditures

For Salaries	$ 6,080.64	
For Office Expenses	19.44	
For Traveling Expenses	3,621.18	
For General Supplies	783.46	
For Miscellaneous Expenses	450.66	$ 10,955.38
Balance Carried Forward May 1, 1921		$ 3,727.89

Bee Disease Eradication

Resources

Balance Brought Forward May 1, 1920	$ 2,147.78
Appropriation Available July 1, 1920	5,000.00
	$ 7,147.78

Expenditures

For Salaries	$ 4,222.84	
For Office Expenses	128.15	
For Traveling Expenses	1,098.75	
For Printing	42.75	
For General Supplies	177.93	
For Miscellaneous Expenses	4.26	$ 5,374.68
Balance Carried Forward May 1, 1921		$ 1,473.10

Incidental Fund

Resources

Balance Brought Forward May 1, 1920	$ 4,282.65
Incidental Collections During the Year	3,646.07
	$ 7,928.72

Expenditures

For Salaries	$ 879.86	
For Office Expenses	450.91	
For Traveling Expenses	552.65	
For General Supplies	526.83	
For Miscellaneous Expenses	881.61	$ 3,291.86
Balance Carried Forward May 1, 1921		$ 4,636.86

J. T. Diamond,
Secretary, State Plant Board.

FINANCIAL REPORT

For Period from May 1, 1921 to June 30, 1922

Tallahassee, Florida, August 1, 1922.

To the State Plant Board:

Gentlemen: I herewith submit the following report of the finances of the Board for the period beginning May 1, 1921 and ending June 30, 1922:

Summary

Resources

General Fund, continuing appropriation of $35,000 annually		$ 70,000.00
Citrus Canker Eradication		15,703.97
Nursery Inspection		7,668.11
Quarantine Inspection		7,154.77
Sweet Potato Weevil Eradication		3,727.89
Bee Disease Eradication		1,473.10
Incidental Fund		7,528.34
State Plant Board Work, Chapter 8441, Acts of 1921		150,000.00
		$263,256.18

Expenditures

General Fund	$ 23,214.29	
Citrus Canker Eradication	15,702.27	
Nursery Inspection	7,667.93	
Quarantine Inspection	7,154.49	
Sweet Potato Weevil Eradication	3,727.31	
Bee Disease Eradication	1,472.43	
Incidental Fund	5,852.15	
State Plant Board Work, Chapter 8441	150,000.00	$214,790.87
		$ 48,465.31
Balance reverting to the State July 1, 1921	$ 3.41	
Balance reverting to the State May 1, 1922	16,775.12	
Balance carried forward July 1, 1922	31,686.78	$ 48,465.31

General Fund

Resources

Appropriation Available May 1, 1921		$ 35,000.00
Appropriation Available May 1, 1922		35,000.00
		$ 70,000.00

Expenditures

For Salaries	$ 15,082.46	
For Office Expenses	2,457.99	
For Traveling Expenses	2,666.12	
For Printing	1,584.18	
For General Supplies	818.42	
For Miscellaneous Expenses	605.12	$23,214.29*
		$46,785.71
Balance reverting to the State May 1, 1922	$ 16,775.12	
Balance carried forward July 1, 1922	30,010.59	$ 46,785.71

*The disbursement of the General Fund for the period from May 1, 1921 to June 30, 1922, classified by departments and projects rather than by items, was as follows:

Secretary's Office	$ 1,506.51
General Expenses	12,128.30
Department of Entomology	6,581.22
Mosaic Disease Eradication	1,678.12
Citrus Canker Eradication	1,301.18
Quarantine Inspection	18.96
	$23,214.29

—Plant Commissioner

Citrus Canker Eradication

Resources

Balance Brought Forward May 1, 1921		$ 15,703.97

Expenditures

For Salaries	$ 8,604.71	
For Office Expenses	1,244.39	
For Traveling Expenses	4,761.69	
For General Supplies	1,091.48	$ 15,702.27
Balance reverting to the State July 1, 1921		$ 1.70

Nursery Inspection

Resources

Balance Brought Forward May 1, 1921		$ 7,668.11

Expenditures

For Salaries	$ 2,881.86	
For Office Expenses	1,223.34	
For Traveling Expenses	2,452.15	
For Printing	1,053.50	
For General Supplies	57.08	$ 7,667.93
Balance Reverting to the State July 1, 1921		$ .18

Quarantine Inspection

Resources

Balance Brought Forward May 1, 1921		$ 7,154.77

Expenditures

For Salaries	$ 4,436.34	
For Office Expenses	697.28	
For Traveling Expenses	1,566.39	
For General Supplies	454.48	$ 7,154.49
Balance Reverting to the State July 1, 1921		$ .28

Sweet Potato Weevil Eradication

Resources

Balance Brought Forward May 1, 1921		$ 3,727.89

Expenditures

For Salaries	$ 1,177.50	
For Office Expenses	31.77	
For Traveling Expenses	828.68	
For General Supplies	1,413.38	
For Miscellaneous Expenses	275.98	$ 3,727.31
Balance Reverting to the State July 1, 1921		$ .58

Bee Disease Eradication

Resources

Balance Brought Forward May 1, 1921		$ 1,473.10

Expenditures

For Salaries	$ 1,176.82	
For Office Expenses	3.82	
For Traveling Expenses	290.54	
For General Supplies	1.25	$ 1,472.43
Balance Reverting to the State July 1, 1921		$ .67

Incidental Fund

Resources

Balance Brought Forward May 1, 1921		$ 4,636.86
Receipts from May 1, 1921 to June 30, 1922		2,891.48
		$ 7,528.34

Expenditures

For Salaries	$ 1,242.43	
For Office Expenses	255.18	
For Traveling Expenses	184.34	
For Printing	168.75	
For General Supplies	471.07	
For Miscellaneous Expenses	3,530.38	$ 5,852.15
Balance Carried Forward July 1, 1922		$ 1,676.19

State Plant Board Expenses—Chapter 8441, Acts 1921

Resources

Appropriation Available July 1, 1921		$150,000.00

Citrus Canker Eradication

For Salaries	$ 37,317.39	
For Office Expenses	599.40	
For Traveling Expenses	23,791.78	
For General Supplies	1,456.76	
For Miscellaneous Expenses	1,386.54	$ 64,551.87

Nursery Inspection

For Salaries	$ 23,531.89	
For Office Expenses	515.84	
For Traveling Expenses	12,543.33	
For Printing	194.77	
For General Supplies	24.56	
For Miscellaneous Expenses	159.21	$ 36,969.60

Quarantine Inspection

For Salaries	$ 23,830.75	
For Office Expenses	239.93	
For Traveling Expenses	6,328.60	
For Printing	382.75	
For General Supplies	207.95	
For Miscellaneous Expenses	114.08	$ 31,104.06

SWEET POTATO WEEVIL ERADICATION

For Salaries	$ 3,211.23	
For Office Expenses	11.29	
For Traveling Expenses	1,847.72	
For Printing	4.50	
For General Supplies	53.02	
For Miscellaneous Expenses	675.00	$ 5,802.76

BEE DISEASE ERADICATION

For Salaries	$ 6,863.12	
For Office Expenses	73.12	
For Traveling Expenses	1,963.24	
For Printing	2.50	
For General Supplies	52.77	
For Miscellaneous Expenses	3.66	$ 8,958.41

BOLL WEEVIL INVESTIGATION CONTROL

For Salaries	$ 1,505.54	
For Office Expenses	49.59	
For Traveling Expenses	507.40	
For General Supplies	432.44	
For Miscellaneous Expenses	118.33	$ 2,613.30
		$150,000.00

Respectfully submitted,

J. T. DIAMOND,

Secretary, State Plant Board.

ESTIMATES

The following estimates on the amounts of money required for carrying out the duties imposed upon the State Plant Board by the provisions of the Florida Plant Act of 1915 (Chapter 6885) and Chapter 7938, are made with due regard to past experience in dealing with the problems involved and to the wisdom of affording the State's varied agricultural interests adequate protection against insect pests and plant diseases, some of which may easily cause losses running into the millions of dollars. The Plant Board is now compelled to pay higher salaries than ever before to the trained men necessary to efficiently conduct its work.

The various activities to which these estimates refer and the necessity therefor are quite fully explained in the foregoing pages of this report:

Estimated Expenses per Annum

For Fiscal Years Ending June 30, 1923 and June 30, 1924

General Expenses

Traveling Expenses of Board Members, Salary of Secretary, Salary of Plant Commissioner, Salaries of Stenographer, Clerks and Janitor in Plant Commissioner's Office, Publications, Postage, Stationery, Telegrams, Telephone, Supplies, etc., per annum	$ 15,000

Quarantine Department

Salaries, Traveling Expenses, Port Expenses, Boat Hire, Quarantine Notices, Parcel Post Plant Inspection, etc., per annum	$ 50,000

Nursery Inspection

Salaries, Traveling Expenses, Tags, Filing Furniture, Stationery, Postage, etc., per annum	$ 45,000

Citrus Canker Eradication

Salaries, Traveling Expenses, Disinfectants, etc., for Eradication of Citrus Canker and Maintaining Grove Inspection for Detection of Citrus Canker, Black Fly and other Dangerous Pests and Diseases, per annum	$125,000

Sweet Potato Weevil Eradication

Salaries, Traveling Expenses, Supplies, etc., for Conducting Eradication of Sweet Potato Weevil in Baker County in Cooperation with the Bureau of Entomology, United States Department of Agriculture, Inspecting Sweet Potato Fields and Plant Beds, Administering Quarantines to Prevent the Spread of the Weevil, etc., per annum	$ 5,000

Control of Mosaic Disease of Sugar Cane

For Production of Cayana 10 Variety (resistant to disease) for Distribution in Infected Areas in North Florida and for Prevention of Spread, per annum	$ 2,500

Cotton Boll Weevil Investigations

For Continuing Investigations and Development of Methods of Controlling Cotton Boll Weevil and Demonstrating Same, per annum	$ 10,000

Department of Entomology

Salaries of Entomologist, Associate Entomologist and Stenographer, Filing Cases and Other Equipment, per annum	$ 7,500

Bee Disease Eradication

For Eradicating and Preventing Spread of Diseases of Honeybees in Accordance with Provisions of Chapter 7938, Laws of Florida, per annum	$ 10,000

Total Requirements, per annum	$270,000
Total Requirements for Biennium	540,000
Less Continuing Appropriation $35,000 per annum	70,000
Special Appropriations Required for Biennium	$470,000

In addition to the above the Plant Commissioner again urgently recommends the appropriation of not less than $250,000.00 as an emergency appropriation to become available for the use of the State Plant Board, only and in the event that the pink bollworm of cotton, the Mexican bean beetle, the Japanese camphor scale or the blackfly should make its appearance in the State. Should any one of these pests succeed in obtaining a foothold in Florida the cost of eradication would be increased to many hundreds of thousands of dollars if the Board were obliged to defer action until the succeeding session of the legislature.

It is also respectfully suggested that such amount as may appear to be necessary for the purpose be appropriated for the erection of a suitable building, on the grounds of the University at Gainesville, for the accommodation of the Board's offices, laboratories, etc.

Respectfully submitted,

WILMON NEWELL,
Plant Commissioner.

Gainesville, Florida,
November 24, 1922.

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

QUARANTINE DEPARTMENT

REPORT ON INSPECTIONS AND INTERCEPTIONS, ALL PORTS AND STATIONS, FOR THE QUARTER ENDING DECEMBER 31, 1922

SHIPS INSPECTED:		
From foreign ports	508	
From U. S. ports other than Florida	395	
From Florida ports	160	
Total		1,063
NUMBER OF PARCELS INSPECTED:		
Arriving by water:		
Passed	199,115	
Treated and passed	22,402	
Returned to shipper	146	
Contraband destroyed	210	
Total		221,873
Arriving by land, express, freight, wagon, etc.:		
Passed	1,980	
Treated and passed	55½	
Returned to shipper	78	
Contraband destroyed	233½	
Total		2,347

Arriving by mail:		
Passed	345½	
Treated and passed	14	
Returned to shipper	20	
Contraband destroyed	½	
Total		380
GRAND TOTAL OF PARCELS INSPECTED		224,600

Number of parcels on hand pending determination as to final disposition	85	
Total Parcels Passed	201,440½	
Total Parcels Treated and Passed	22,471½	
Total Parcels Returned to Shipper	244	
Contraband Destroyed	444	
GRAND TOTAL		224,600

Two notable interceptions of pests of major importance were made during the quarter: Black fly on spice from the British West Indies and West Indian fruit fly in guava from Cuba.

BEE DISEASE ERADICATION

REPORT FOR QUARTER ENDING DECEMBER 31, 1922

Number of apiaries inspected	195
Number of apiaries infected with American Foul Brood	2
Number of colonies inspected	4,627
Number of colonies infected with American Foul Brood	2
Number of apiaries infected with European Foul Brood	0
Number of colonies infected with European Foul Brood	0

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK IN COOPERATION WITH THE BUREAU OF PLANT INDUSTRY, FOR QUARTER ENDING DECEMBER 31, 1922

Citrus grove trees inspected	1,022,011
Citrus nursery trees inspected	22,950,868
Inspectors employed	96
Inspectors employed on canker eradication	56
New properties showing active infection	3
Total properties showing active infection	9
Grove trees found infected	35
Nursery trees found infected	6
Counties in which active infections were found	1

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	15,140
Nursery trees found infected since May, 1914	342,260
Number properties infected to Dec. 31, 1922	509
Properties declared no longer "Danger centers"	486
Properties still classed as "infected" Dec. 31, 1922	23

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to December 31, 1922:

1914		1915		1916		1917		1918		1919		1920		1921		1922	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0	Jan.	0	Jan.	0	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0	Feb.	0	Feb.	0	Feb.	0
		Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1	Mar.	0	Mar.	0	Mar.	0
		Apr.	408	Apr.	49	Apr.	169	Apr.	2	Apr.	1	Apr.	0	Apr.	0	Apr.	0
May	108	May	1042	May	338	May	52	May	1	May	1	May	0	May	0	May	585
June	160	June	772	June	450	June	45	June	10	June	0	June	0	June	0	June	[illegible]
July	275	July	651	July	349	July	39	July	0	July	0	July	539	July	0	Jul.	[illegible]
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0	Aug.	1	Aug.	1	Aug.	0	Aug.	34
Sept.	767	Sept.	618	Sept.	124	Sept.	6	Sept.	0	Sept.	0	Sept.	0	Sept.	0	Sept.	23
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0	Oct.	0	Oct.	0	Oct.	0	Oct.	19
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0	Nov.	0	Nov.	0	Nov.	0	Nov.	12
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0	Dec.	0	Dec.	0	Dec.	0	Dec.	4
Tot.	4327		6715		2294		372		15		4		540		0		873

CITRUS TREE QUARANTINE CONTINUED

The State Plant Board, at a public hearing called for the purpose and held at Tallahassee January 8, 1923, considered fully the advisability or desirability of amending or continuing in force its Rule 25, which prohibits shipment into this state of citrus nursery stock. At this hearing many growers and representatives of organizations were present. Numerous communications and petitions were presented to the Board. After full consideration of the views as expressed by the speakers and petitioners, as well as of the information submitted to the Board by members of its staff, the Board has determined to make no change whatever in its present rule. Rule 25 therefore continues operative and the shipment of citrus nursery trees into the State of Florida is PROHIBITED. The Board regards this prohibition as a necessary safeguard to protect the citrus industry against the introduction of numerous serious pests which otherwise might gain entrance.

A great quantity of extremely interesting and informative material was developed at the hearing. The statement had been given wide publicity that there was a great shortage of Satsuma nursery stock in Florida and that a large supply was available elsewhere. The first part of this statement was admitted to be correct. The latter portion, it was shown, possessed no foundation whatever, for the Satsuma nursery stock shortage is just as acute in other states as in Florida. Consequently, a "letting down of the bars", even though such a course of procedure could have been adopted with comparative safety, would not relieve the sit-

uation in which west Florida citrus planters found themselves this year and which was the reason for the petitioning of the Board to amend its rule. The situation is due to a great stimulation of interest in north and west Florida in the planting of Satsuma orange groves, causing a demand for planting stock much in excess of the available supply in Florida nurseries. It was further developed at the hearing that Florida citrus nurseries are and have been fully aware of the shortage and of the increased demand which will apparently continue for some time and have made their plans for production accordingly. It is evident that Florida nurseries will be able to provide sufficient Satsuma trees next season and for succeeding seasons to take care of a normal, safe and conservative planting program.

The amount of Satsuma buds on trifoliata stock available from Florida nurseries for the planting season of 1922-23 has been estimated at 150,000. The demand has been for approximately 250,000. The Board, through its inspection service, is informed that there are now over 800,000 citrus trifoliata seedlings in Florida nurseries which have already been budded or will be budded this coming spring. There is therefore in sight a supply of at least one-half million Satsuma trees for planting in 1923 and 1924, or sufficient to plant 7,000 or 8,000 acres. The Board's records show that in Florida west of the Aucilla River there were in grove formation last fall 1117½ acres of citrus. It will thus be seen that with this season's plantings and the stock available for the coming year the acreage can and will be greatly increased.

Aside from the foregoing considerations of nursery stock supply, the Board gave careful attention to the protective aspect of the problem. Information was submitted indicating that in Alabama, Mississippi, Louisiana and Texas (the states producing Satsuma stock) there exist several plant pests attacking citrus which pests are not now present or widely distributed in Florida. These plant pests are of major importance with respect to the damage done. If introduced into Florida they would occasion the expenditure of enormous sums of money to complete eradication and to control. There are not adequate or practical means of preventing introduction except by prohibition of entry of host plants or fruits. The Quarantine Inspection Service of the Board is totally inadequate to properly handle shipments if made under regulations requiring inspection and treatment, and in the case of some of the plant pests no suitable method of treatment is

known. In response to the several reasons here set forth and others equally cogent, and also reacting to the overwhelming demand of growers and business interests that no change be made in the rule, the Board continued in effect Rule 25.

The public hearing was well attended, about forty men participating. There was no division of opinion whatever as regards the sentiment of citrus growers in the peninsular section. Even among growers and prospective planters in west Florida, where sentiment at one time strongly favored a modification of the prohibitory rule, the preponderance of opinion negatived any change, particularly one which would expose the growing young industry to danger. This revulsion of feeling was indicated through addresses to the Board, letters and petitions. The Board is much gratified at the general spirit of cooperation and support of the Board's work which was manifested. Its decision is, it is felt, based upon a sound foundation and will, the Board is assured, be approved by the people of the state as a whole. The protection of the state's horticultural interests is of prime importance and the Board, through its staff, will render to the state the best service possible with the facilities available.

THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. VII April, 1923 No. 3

THE QUARANTINE SITUATION—WHAT IS NEEDED*

WILMON NEWELL

The time seems opportune for calling your attention to the general situation with reference to quarantine protection (a) against importation into this country of injurious insects of plants and plant diseases from foreign countries; (b) against wider distribution of certain imported plant pests which are already established.

Our experience with the boll weevil, pink bollworm, Argentine ant, various species of whitefly, Mexican bean beetle and, recently, the Japanese camphor scale, should be sufficient to impress upon us the lesson that prevention is the thing most to be desired and the one thing, above all others, for which we should strive. That there are still a great many serious plant pests which have not been already introduced and the introduction of which should be guarded against is so well known that it is not necessary to offer evidence in support of the statement.

What some of us do not realize, however, is that the opportunities for these pests to get in are still numerous and that only some of the avenues of entrance have been closed up. Most of us do not realize, either, that dangerous plant material arrives every day, at every port of the United States, regardless of whether quarantine inspectors are stationed at these ports or not. We will presently throw on the screen a table (Table No. 1) which shows the immense amount of material inspected at the Florida ports since 1915 and, also, a list of some of the injurious and dangerous pests that have been found therein. (Table No. 2.) We do not know how many dangerous pests have gotten by our Florida inspectors, even at that. How much more certain must it be, with no inspection service at such ports as Mobile and Galveston, that injurious insects are entering in almost a steady stream. It is not likely that the pests, entering now and becoming established, will come to our attention for a number of years to

*Paper presented at Memphis, Tennessee, February 7, 1923, Annual Meeting Association of Southern Agricultural Workers.

TABLE I

THE FOLLOWING TABULATION IS PRESENTED SHOWING THE WORK OF THE QUARANTINE DIVISION, STATE PLANT BOARD OF FLORIDA, BY YEARS SINCE THIS WORK WAS INAUGURATED

	1915-16	1916-17	1917-18	1918-19	1919-20	1920-21	1921-22	May and June, 1922	Total
Foreign boats	166	1240	1777	1724	2458	3035	2225	364	12989
Total boats	370	3257	4253	3485	4504	4948	4179	697	25693
No. packages arriving by boat, express, freight, mail	500	3105	3422	*69985	336059¾	710412½	1333333½	747972	3204789¾
Number packages returned	18	255	485	1521	4936½	2130½	2610	201	12157
Number packages destroyed	69	1182	1037½	1743¾	2345½	1564⅓	1757	311	9989

*Prior to August 1, 1918, horticultural material inspected was reported by shipments. A shipment might comprise 1 or 1,000 packages. Subsequent to above date reports were made of the number of packages and bulk shipments were reduced to packages on basis of contents of standard containers used for particular products.

TABLE II

SOME IMPORTANT FOREIGN PESTS INTERCEPTED BY FLORIDA INSPECTORS FOR PERIOD FROM DECEMBER 13, 1915 TO APRIL 30, 1922

INSECT OR DISEASE	From	Number of Shipments Infested
Aspidiotus destructor Sign.	Cuba	62
Aspidiotus destructor Sign.	Porto Rico	2
Aspidiotus fabernii Houser	Cuba	1
Aspidiotus palmae Morg. & Ckll.	Spanish Honduras	1
Aspidiotus subsimilis var. *anonae* Houser	Cuba	6
Aspidiotus subsimilis var. *anonae* Houser	Bahama Islands	1
Asterolecanium sp.	Spanish Honduras	1
Asterolecanium miliaris longum Green	Cuba	1
Bephrata cubensis Ash.	Cuba	4
Black Fly	Bahama Islands	5
Black Fly	Cuba	17
Lepidosaphes hawaiiensis (Mask.)	Africa	2
Pseudaonidia articulatus (Morg.)	Bahama Islands	8
Pseudaonidia articulatus (Morg.)	Cuba	21
Pseudaonidia articulatus (Morg.)	Mexico	2
Pseudaonidia articulatus (Morg.)	Panama	1
Pseudaonidia tesserata (DeC.)	Bahama Islands	1
Pseudaonidia tesserata (DeC.)	Cuba	5
Pseudischnaspis alienus (Newst.)	Cuba	13
Pseudischnaspis alienus (Newst.)	Mexico	1
Pseudococcus sacchari (Ckll.)	Cuba	1
Pyralid, *Plodia* sp.	India	2
West Indian sweet potato weevil	Bahama Islands	3
West Indian sweet potato weevil	Porto Rico	1
Targionia hartii (Ckll.)	Africa	2
Targionia hartii (Ckll.)	Bahama Islands	19
Targionia hartii (Ckll.)	British Honduras	1
Targionia hartii (Ckll.)	Cuba	15
Targionia hartii (Ckll.)	Grand Cayman	1
Targionia hartii (Ckll.)	Nicaragua	1
Targionia hartii (Ckll.)	Panama	1
Targionia hartii (Ckll.)	Spanish Honduras	1
Targionia sacchari (Ckll.)	Cuba	15
Targionia sacchari (Ckll.)	Bahama Islands	19
Targionia sacchari (Ckll.)	British Honduras	1
Targionia sacchari (Ckll.)	Grand Cayman	1
Targionia sacchari (Ckll.)	Panama	1
Thielaviopsis paradoxa (d. Seyn.) V. Hohn	Cuba	2
Vinsonia stellifera (Westw.)	Bahama Islands	4
Vinsonia stellifera (Westw.)	Jamaica	1
Weevil (*Palaeopus costicollis* Marshall)	Jamaica	1
West Indian fruit fly	Cuba	14

come but the evidence of their introduction most certainly will come, just as the evidence of the introduction of the camphor scale has come to us within the past three years.

Perhaps some of you are under the impression that the Federal Horticultural Board is affording all of us adequate protection against introductions. Such is not the case at all. Out of thirty-

five of the more important maritime and border ports (exclusive of the Canadian line) federal quarantine inspectors are stationed at only fifteen and Federal Horticultural Board collaborators (state inspectors) at ten. At many of these ports the present inspection force is far from adequate. There are nine major ports of entry which are totally unprotected. This situation will be more clearly seen on the map which will be shown presently.

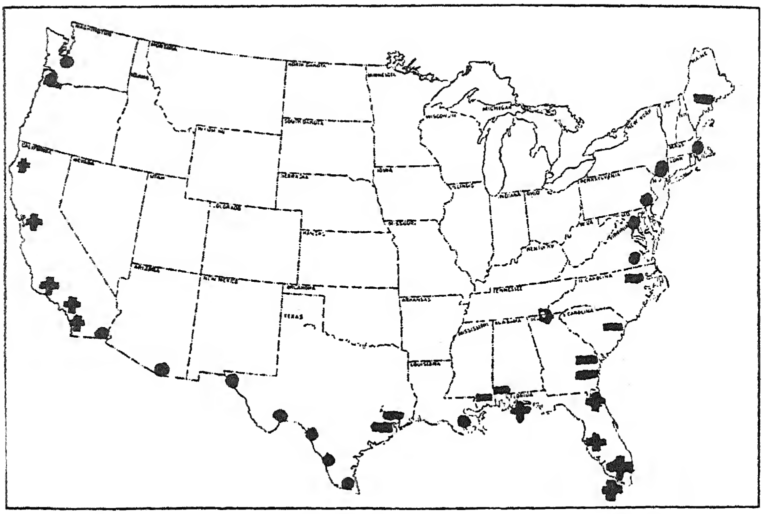

Fig. 3.—Map showing location of plant quarantine inspectors.
• Federal Horticultural Board Inspectors.
+ Collaborators (state inspectors).
— No Inspectors.

The Federal Horticultural Board had, in 1922, $113,410 for enforcing the provisions of the Plant Quarantine Act—inspection, etc.—*exclusive* of amounts expended on the pink bollworm, potato wart, etc. For 1923 the Board has for this work $105,850, a decrease of $7,560. For general expenses of the Board during 1924, the Agricultural Appropriation Bill carries $306,490, which includes the Texas border work on pink bollworm which, in itself, amounts to $134,840, leaving $171,650 for general expenses of the Board. This will permit of an increase of about $20,000 for the maritime port inspection work for 1924, or only $12,350 more than was available for this same work in 1922.

Compare this sum, for the whole country, with the sum of nearly $100,000 being expended by the two states of California and Florida.

The Bulb Situation

I am not at all sure, even, that all the high officials of our Agricultural Department at Washington fully realize the gravity of the present situation. There are indications of a letting up in the policy of increasing protection against foreign pests. Witness the action of the Federal Horticultural Board, on December 22nd, last, in deciding to admit from foreign countries eight kinds of bulbs, in addition to the six kinds already being allowed admission. This was turning the screws the wrong way, in spite of its being generally admitted that there is danger of importing new insect pests with the bulbs, notably the lesser bulb fly *(Eumerus strigatus* Fallen) which actually has been brought in in bulbs and which is a pest of onions in Europe: and a nematode, the bulb eel worm *(Tylenchus devastatrix)* which has already become a clover pest in Idaho.

Importers, on the strength of this action, are already quietly telling dealers that there has been a lightening up of Quarantine 37 and that soon the "lid will be off". They are advising the dealers not to make contracts with American bulb growers, that they—the importers—will soon be able to sell them imported bulbs at a much lower cost than can the American growers. Thus is American bulb-growing discouraged and the insidious propaganda launched against the meritorious Quarantine 37. The action of the Board in admitting more bulbs cannot be regarded as other than a mere action for the sake of expediency: no one has shown that there was any real need for the action.

The Fruit Fly Question

We have other evidence suggesting the lack of an aggressive policy by the Department in affording adequate quarantine protection. On December 20, 1922, there was held, before the Federal Horticultural Board, a hearing on the question of prohibiting or restricting the importation of fruits from all countries as a means of preventing the introduction of the Mediterranean and other fruit flies. No decision on the question has been announced by the Secretary of Agriculture.

There are five courses which might be pursued:

1. Establish no quarantine at all,

2. Provide for inspection of fruits at ports of entry to ascertain whether they contain living fruit fly larvae,
3. Establish a system of admitting fruits under permit,
4. Establish a prohibitory quarantine against all fruits, excepting possibly lemons, bananas and coconuts, or
5. Provide specific quarantines against the host fruits of fruit flies, from countries where infestation is known to exist.

1. If it were not for a very few special federal quarantines and the more comprehensive state quarantines of California and Florida, the country would be wide open for the entrance of fruit flies. The only federal foreign quarantine orders aimed at the exclusion of fruit flies are those:

a. Prohibiting citrus fruits from Mexico on account of the Morelos fruit worm
b. Prohibiting avocados from Mexico on account of the avocado weevil, but allowing entrance of the thick-skinned varieties through the port of New York.

"No quarantine" would simply mean a continuation of the present dangerous conditions.

2. No system of inspection could possibly show maggots *inside* of fruit. There is absolutely no external evidence of their presence. A few months ago the Cuban authorities insisted that, while the mango was subject to infestation by the West Indian fruit fly, the "manga" was a different fruit and not subject to attack. A specimen of the so-called "manga" was secured and sent to us. The day it arrived at our office a very active fruit fly larva ate its way out of the fruit. Here was a single fruit which, first, was said by the Cuban authorities to be immune to attack, and secondly, was most rigidly inspected before being sent us as well as upon its receipt: yet it gave no external evidence of harboring a pest. Imagine the simplicity of inspecting shiploads of fruit for such an insect!

3. The most conspicuous thing about a permit system is the immense amount of red tape which it involves. Here again, the only protection offered is that based upon inspection of the fruit at port of entry unless, indeed, permits be issued only for shipment of fruit from non-infested countries. Here, again, knowledge as to what countries are infested and the degree of infestation is largely lacking.

4. It would appear that the greatest protection would be obtained by an embargo against all foreign fruits and this, incidentally, is what California is asking for at the hands of the

Federal Horticultural Board. Let us recall that the United States is the only important fruit producing country that is still free from injurious fruit flies.

Anyone who has seen thousands of barrels of apples rotting in the orchards of the North, hundreds of carloads of oranges and grapefruit decaying under the trees in Florida and carloads of peaches dumped because of glutted markets, can testify that foreign fruits are not needed in order to supply our population either with sufficient fruit or with fruit at reasonable prices.

5. There is unquestionably strong opposition to any general embargo against foreign fruits and there might be some complication in its application.

It might be feasible to establish quarantines against the host fruits, of fruit flies, from countries where infestation is known to exist. This would be an expansion of the Board's present policy, as illustrated by its quarantine against citrus fruits from Mexico on account of the Morelos fruit worm. Under this plan, for example, a quarantine would be promulgated prohibiting the entry of mangoes from Cuba on account of the West Indian fruit fly, another against the fruit hosts of the Mediterranean fruit fly from Brazil, Spain, etc.

In a general way, the plan of having separate quarantines for specific fruit flies and countries would accomplish much the same thing as a blanket quarantine, without being open to the objection of being too inclusive or, in some instances, hard to defend. For example, apples from Canada would not be excluded, whereas under a blanket quarantine they would be.

Just one fruit industry, citrus, represents in Florida alone an investment of about $400,000,000 and in the United States as a whole probably about a billion dollars. The total value of the fruit industries of the country, likely to suffer through the introduction of fruit flies, runs into the billions.

An active propaganda in opposition to the proposed quarantine on fruits is being waged by powerful business interests of New York City. Members of Congress are being appealed to to use their influence to prevent the imposition of such a quarantine. Press articles antagonistic to the quarantine have been prepared by its enemies and are ready to be released for publication throughout the country in the attempt to prejudice public opinion against effective action by the Federal Horticultural Board. Through all this, the horticulturists, entomologists and phytopathologists seem to be asleep.

Is it not time we were letting the public know what is going on and also letting the Department of Agriculture know that we stand solidly for the protection of the producers of this country; and that we do not stand for the profits of foreigners, importers and middlemen when their prosperity is to be secured at grave risk to the fruit industries of this country?

THE JAPANESE BEETLE

We wish now to direct your attention to just one concrete argument for an immediate and better national quarantine service, namely, the present situation with regard to the Japanese beetle. Not only does this situation force home the lesson of adequate quarantine protection but it is, in itself, a situation fraught with grave danger to the entire eastern United States and one which demands action upon the part of all thinking entomologists and quarantine officials.

Very evidently introduced with Iris bulbs from Japan, this insect was first found in a large nursery near Riverton, New Jersey, in August, 1916—less than seven years ago. When discovered only about a dozen beetles could be collected. I have been told that the infested area was smaller than this room. Even a lazy man could have eradicated the insect then and still have had plenty of time to keep up with his fishing. Here is how the infested area has increased:

Year	Square Miles
1916	.5 (?)
1917	2.5
1918	6.5
1919	48.0
1920	103.0
1921	270.0
1922	703.0

and it is extending its range, in every direction, from 5 to 15 miles a year.

The insect has become one of the most serious pests ever seen in America. Its numbers have increased beyond belief. The adult beetles are so thick in parts of the infested area that fruits are covered with them as with swarms of bees. Peaches—still on the trees—are eaten until nothing remains but the pit. Apples are eaten until only a bare core remains.

It attacks practically all tree and bush fruits, many field and truck crops and a host of wild plants. Two hundred twelve host plants have already been recorded.

Two years ago I visited the Riverton area and was horrified to see Japanese beetle larvae turned up in grass plats with every turn of the shovel. Now, I am told, they have found as many as 1500 larvae to the square yard of sod.

The beetle larvae have made it difficult to maintain the grass on the golf links, especially where the sod is irrigated.

The opportunities for spread of the pest are legion. As larvae they may be carried in soil about the roots of nursery stock, ornamentals and plants of various kinds. As adults they are carried in vegetable containers, fruit boxes, automobiles, railway trains, wagons and, frequently, adhering to the clothing of people.

The infested area is thickly settled (it includes most of the cities of Philadelphia and Camden and several villages) and the rural part of the infested area is devoted mainly to the production of fruits, vegetables and nursery stock. In and near the infested area are nursery interests valued at many millions of dollars: it is in fact the great nursery center of the United States. The farms are given over mainly to fruits and vegetables.

Arsenical poisons merely repel the insect — it does not eat them.

No such grave insect problem has ever presented itself in this country.

What is being done about it?

Merely this. The Bureau of Entomology is investigating the insect. The Federal Horticultural Board proposes to shortly modify its Japanese beetle quarantine so as to maintain only a quarantine that prohibits the movement of dangerous material *out* of the infested area as a whole. Fruits and vegetables produced in the infested sections are to be permitted free movement within the area—into the city of Philadelphia and its markets.

From funds provided for in the present Agricultural Bill there will be available $100,000 for investigation and maintenance of the quarantine just mentioned, but *nothing whatever for a direct attack upon the insect.*

In other words, the Bureau of Entomology is "investigating" the pest and, in the course of two or three years, will probably tell us what I am telling you now: that it is a *very* serious pest. The Federal Horticultural Board draws a line around the infested area and jokingly says to the bug, "You shall not pass". Next

summer the bugs will pass, the Horticultural Board will say, "Beg pardon", move back a few miles and draw another quarantine line, and so on, until the line surrounds most of the United States.

Where would we be today, if we had merely drawn a quarantine line around our citrus canker infections and allowed the disease to increase, within the quarantined areas, at its own sweet pleasure?

Every entomologist knows full well that a quarantine around an area in which a flying insect breeds by millions is little more than talk.

Are we, in the South, interested in this matter? We are, for there is nothing to indicate that the Japanese beetle would not be as serious a pest in Florida or Texas as it is in New Jersey. In Japan the range of the insect is from the latitude of New Jersey clear down into the Satsuma growing sections.

There is but one explanation for this "Let-Her-Go-Gallagher" policy on the part of the Department of Agriculture. Local interests in the infested area are trying to fool themselves and the public into the idea that this thing is not serious: they are trying to keep it quiet. Congress says: "If this is so serious a thing, why are not the people in the affected territory asking us for help?" "Why does not the Secretary of Agriculture request us to appropriate for control of this pest?" Why the Department of Agriculture proposes to let this insect become a pestilence without making any effort whatever to subdue it, is beyond comprehension. Indifference on the part of the people in the area now infested can never justify the Department in ignoring this situation. The Department, with the best scientists in the world, is supposed and expected to recognize dangers long before the layman does and to act accordingly. Ten or twenty years hence the people of New Jersey and Pennsylvania and the nation will say to the Department: "You should have known and you should have done the right thing, whether we agreed with you or not."

This body should not delay in advising the Honorable Secretary of Agriculture and the southern members of Congress, just where it stands on this question. We should insist upon the government taking immediate and vigorous action to reduce or eradicate this pest in the affected area. In two or three years more any semblance of subjugation will be an impossibility and then—we will pay tolls to the pest every year amounting to many millions of dollars.

Other instances of a lack of appreciation by the Department of dangers and of its responsibilities could be cited but it is hardly necessary to do more now than call attention to the recent refusal of the Federal Horticultural Board to take active measures against the Japanese camphor scale. This, however, is a subject which will doubtless receive special consideration at this meeting.

SUMMARY

The Japanese beetle is sufficient argument unto itself for more stringent quarantine measures. We also have all the pests in the South now that we can deal with. Let us insist:

1. That the Department of Agriculture abandon so-called expediency and get down to business with efficient quarantines for preventing the introduction of foreign pests.

2. That the Department adopt, for the future, a more vigorous policy in eradicating or repressing such foreign pests as may become established.

3. That vigorous, direct measures be taken without delay for repression of the Japanese beetle in the affected territory.

4. That the Federal Horticultural Board be given the financial support which its important work deserves.

AN UNUSUAL OUTBREAK OF THE ORANGE BASKET WORM

(Palatoeceticus gloverii Pack.)

CHARLES M. HUNT*

The Orange Basket Worm, the small caterpillar of a species of bagworm, has been known to occur in the citrus groves of Florida for many years. According to Mr. H. G. Hubbard (Insects Affecting the Orange, 1885), it was Mr. Glover who first recorded it (Patent Office Agricultural Report for 1858). While heretofore recognized as only a minor pest of citrus, it appears to have assumed the role of a major pest in at least two instances early this year.

On January 17, 1923, a grower at Avon Park, Florida, reported that a queer looking worm was eating his oranges and requested us to look over his grove and tell him what to do. He stated that he first noticed the insects on one Valencia orange tree in a forty acre grove during November, 1922, that they had slowly spread over the entire grove until almost every tree held three or four scarred oranges and that quite a number of trees

*Assistant Nursery Inspector.

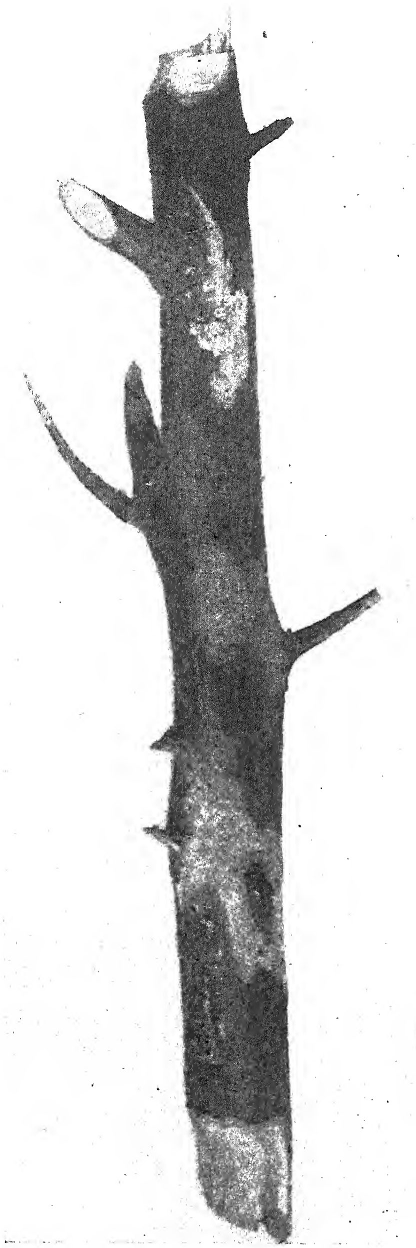

Fig. 4.—Orange Basket Worm injury to small branch (original)

loaded with fruit were severely infested. At his request, Mr. O. D. Link, also an inspector of the State Plant Board, and the writer went over this entire grove, where we found approximately forty trees, loaded with fruit, with nearly every fruit scarred and a large number of the worms on the fruit, foliage and smaller branches. Specimens of the caterpillars, damaged fruit and injured twigs were collected and mailed to the Entomological Department of the Plant Board at Gainesville. The Department identified the caterpillar as the orange basket worm *(Palatoeceticus gloverii* Pack.). At the time of the first inspection the grower was advised to spray his badly infested trees with arsenate of lead. When last inspected, March 5, 1923, it was difficult to find any of the caterpillars on the trees sprayed.

On March 3, 1923, a fruit buyer reported that a fruit worm had damaged 50% of the orange crop in a grove at Sebring. The report was immediately investigated. The grove reported to be so badly infested is located about three miles north of Sebring; it contains sixty-six acres, approximately 10 acres in pineapple oranges,

20 acres Valencias and the balance grapefruit, all about seven years old. It was found that the Valencia oranges in this grove were severely infested by caterpillars — the orange basket worm— but not as badly as had been represented. An estimate made by counting the fruits on forty scattered trees showed an average of 21 scarred oranges to the tree. The average number of oranges to the tree was 160, which made about 13% damage to the Valencia crop in this grove. The worms in all stages were found on the trees at this time. The majority were on the fruit but quite a few were observed feeding on the small twigs and the very young growth.

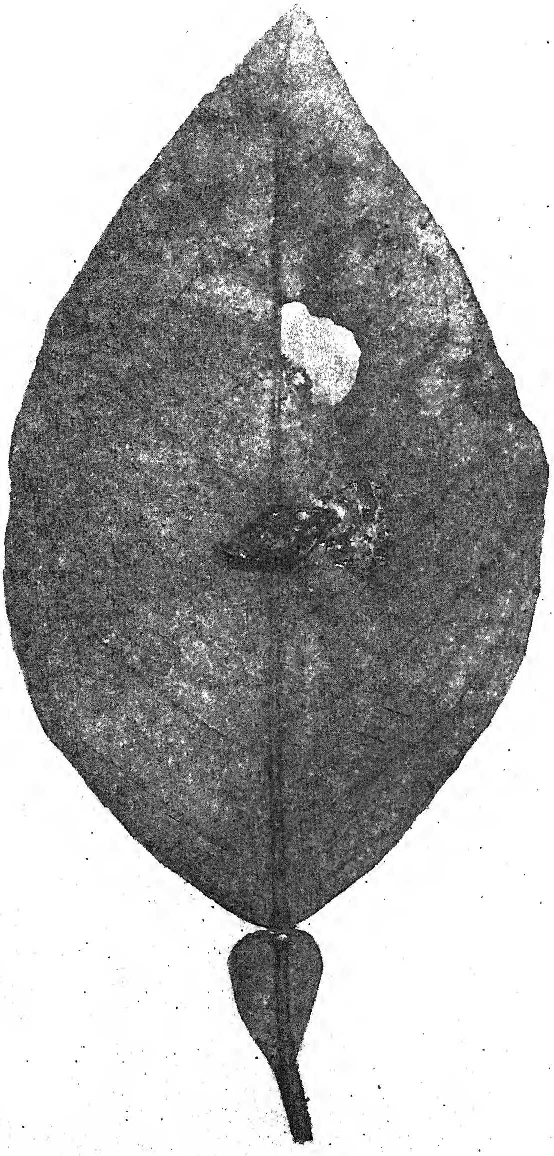

Fig. 5.—Basket Worm injury to mature leaf (original)

The damage on grapefruit was very slight, as only a dozen fruits in the entire grove were found injured. As the pineapple oranges had been picked, an estimate as to the damage on these could

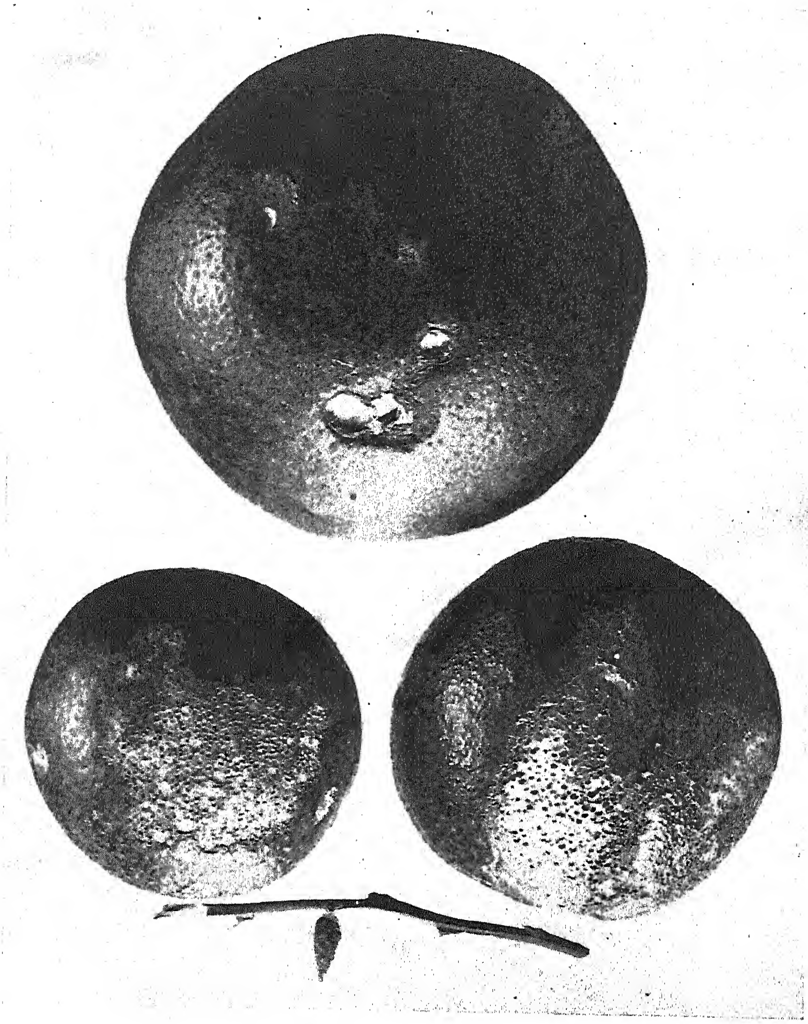

Fig. 6.—Orange Basket Worm on twig and injury to oranges and grapefruit (original)

not be made, but we were informed that they are just as susceptible as the Valencias.

This grove had been sprayed very little during the preceding summer and fall. It had not been hoed at all during the fall and

winter so that there was plenty of grass and trash under the trees which may or may not have had something to do with the severe infestation described.

In order to find out how much territory was infested and the approximate damage, the writer inspected over 400 acres surrounding the infested grove. The two groves on the south and west of the infested grove averaged about six scarred oranges to each tree holding about 150 fruits. Very few damaged fruits were found on the grapefruit trees.

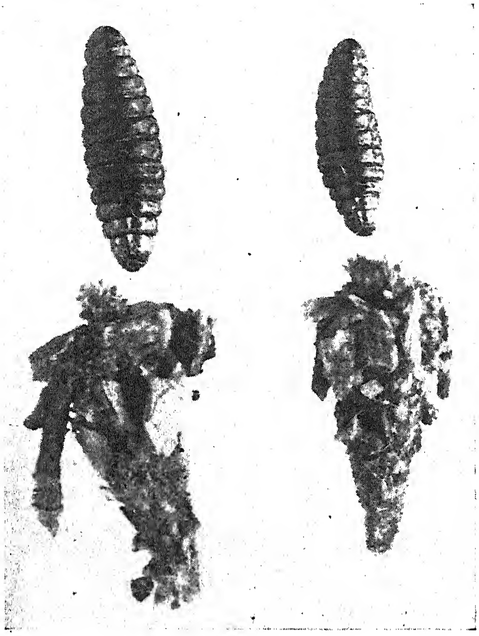

Fig. 7.—Orange Basket Worm showing worms and baskets (original)

The groves located one-fourth to one-half mile from the badly infested grove averaged about three scarred oranges to a dozen trees and in nearly every instance a worm was found at the same time. The farther from the severely infested grove we went, the more difficult it was to find any trace of the worms, suggesting that this grove was the center of the infestation. It must be remembered that the badly infested grove had not been thoroughly sprayed, while all of the groves surrounding the badly infested grove had been sprayed once or twice late in the fall.

The manager of the most severely infested grove stated that the worms were first observed in the groves about October feeding on pineapple oranges. They became more numerous in November and December; then in January and February very little increase was noticed (probably due to the fact that the pineapple oranges were being picked about that time). Toward the last of February the worms began to attract attention because of their rapid increase on the Valencias, until on March 5th the condition was reported as being at its worst.

While the greater percentage of the worms was found on the fruit, nevertheless they appeared to be equally at home on young growth and twigs, but did not seem to do much damage to the old leaves.

On the fruit the worms eat through the epidermis (outer skin) and about half way through the oil cells leaving irregular scarred patches from one-fourth square inch in area up to a square inch or more. Occasionally the worm eats a small hole not much larger in diameter than its body clear through the rind to the pulp of the orange but has not been observed to eat the pulp or go in any further than the pulp. The worms do not appear to prefer any special point on the orange to start eating. When found on grapefruit they eat deeper into the rind and not so much of the epidermis. On the branches and old leaves they eat the epidermis only, but will eat the young, tender growth entirely.

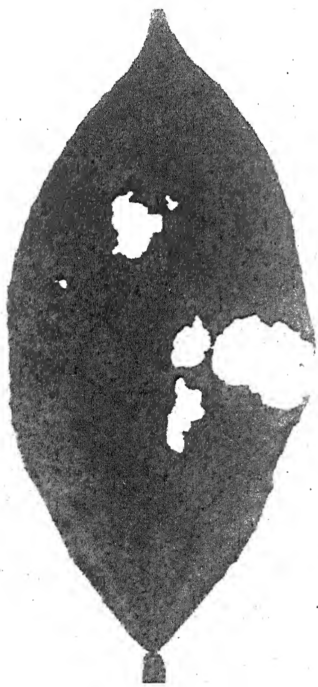

Fig. 8.—Injury to young orange leaf by orange basket worm in confinement. Note that it has eaten through the leaf — not only on the surface (original).

Figures 4, 5, 6, 7 and 8 are from photographs of the orange basket worm and also show the damage done by the worms to the fruit, twigs and leaves.

The Orange Basket Worm is described as follows: Its basket is spindle-shaped. That of the female is 7/10 inch long and that of the male ½ inch long. It consists of a densely matted silk-like material covered with finely chopped bits of dry leaf, bark, moss and other scraps, supplemented not infrequently with the remains of scale insects. As an additional protection, several small orange thorns or little sticks may be fastened to the outside of the case with their sharp tips projecting outward and backwards. The pupa case is dark mahogany-brown in color, and the sutures (lines between the joints) are opaque-black, forming on the female pupa, three, and on

the male, four very distinct rings. The mature or adult male is a small, dark brown moth, measuring 64/100 inch across the extended wings. The female is wingless and does not emerge as a moth, but fills her sac or basket with eggs and then dies. The caterpillars are dirty brown or gray in color. When a basket worm wants to move from one place to another, it pushes forth the front end of its body and creeps along, carrying its house with it. The first three joints which bear the legs and are protruded from the case when the caterpillar moves about, are protected by horny shields. In the young the case is carried erect by the upturned rear end of the body, whereas the older worms carry it horizontally, or pendant when on the underside of a leaf or twig. When full grown, the sac is fastened to a twig and the caterpillar changes to a pupa within it.

Whenever these worms appear in a grove in considerable numbers they may be controlled by spraying with a stomach poison, such as arsenate of lead. Basic arsenate of lead may be added safely to an oil-emulsion spray, but acid arsenate of lead must be applied separately.

A SERIOUS PEST OF THE GRAPE IS NOW PRESENT IN FLORIDA

BY JEFF CHAFFIN*

BAKER'S MEALY-BUG
(*Pseudococcus maritimus* Ehrh.)

This insect has recently been collected on cedar in the vicinity of Hudson and Port Richey by Messrs. O. D. Link and W. M. Tillman, Inspectors of the State Plant Board. It had previously been collected from avocado, sweet potato and tomato on Dry Tortugas Island near Key West, but this is the first record we have of its presence on the mainland of Florida.

It is reported that this particular mealy-bug will thrive on almost any wild or cultivated plant, and it thus seems probable that it may become a serious menace to the grape and other horticultural industries of this state. An extremely wide diversity of taste is, furthermore, indicated by the few hosts so far listed for Florida. (See previous paragraph.) The climatic conditions of Florida appear to be unusually favorable for the development of this mealy-bug. The first brood appears here the

*Assistant Nursery Inspector.

latter part of March and first of April, while in California the first brood does not appear until June. It seems desirable to give a brief outline of its history and habits, and warn the growers of its presence.

This mealy-bug was first noticed in California on *Eriogonum latifolium* and described by Ehrhorn in 1900. Nothing more was heard of it until 1910, when it was reported as doing slight damage in every walnut grove and many apple and pear groves in several counties in California. The seriousness of this pest and its economic importance were not fully realized until several years later when it became well established in the grape growing sections.

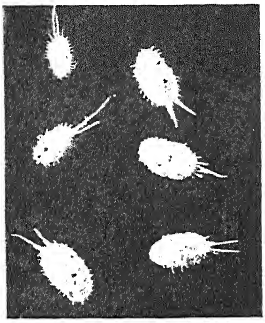

Fig. 9.—*Pseudococcus maritimus* Ehrh. Greatly enlarged (original).

The U. S. Bureau of Entomology and the California Experiment Station have carried on experiments in its control for some years, but so far are unable to recommend any reliable or satisfactory method. The best they have done is to offer suggestions for checking its spread. After it becomes well established in a vineyard its eradication or control is almost impossible. The damage caused by this insect is not so much the result of any injury to the grapevine itself, but rather to the fruit, by reducing its market value. The honey dew, sooty mold, egg masses and cast off skins of the various molts when scattered through a bunch of grapes render it unfit for use. The presence of only a few insects will give a bunch a sticky, repulsive appearance.

We know what this mealy-bug will do to the grape and it is quite probable that if the insect gains foothold in Florida and becomes well established it will become a serious pest on many of our tropical fruits.

A NEW SCALE INSECT FROM FLORIDA

(Order: Hemiptera. Family: Coccidae)

BY G. B. MERRILL*

The new species of scale insect described below was found among other scale insects on material sent in by Mr. Jeff Chaffin, Assistant Nursery Inspector of the State Plant Board of Florida, during January, 1920. Upon examining this material under the binocular microscope a rather peculiar looking scale was seen. Examination of slide mounts proved exceedingly interesting and the search through a considerable lot of Coccid literature and specimens rather conclusively showed that this was an undescribed species. Shortly after receiving the specimens from Mr. Chaffin, Messrs. T. J. Baker and Harold Mowry, Assistant Quarantine Inspectors, then stationed at Jacksonville, Florida, intercepted this same species on croton from St. Lucie, B. W. I. and on custard apple from Santiago, Cuba. The species has been tentatively placed in the genus Targionia Sign.

Fig. 10.—*Targionia quohogiformis* n. sp. Showing six scales. Enlarged. (Drawn by Miss Elita Lovejoy.)

Targionia quohogiformis n. sp. (Quohog-shaped Scale.)

Scale of female: From 1-1.4 mm. long, oval and nearly one-half as thick (Fig. 10). Shape, very similar to that of the Round Clam *(Venus mercenaria)* commonly called Quohog. The dorsal (upper) and ventral (lower) scales are placed more or less laterally, the ventral scale being unusually developed and forming with the dorsal a bivalve-like arrangement. The union of dorsal and ventral scales is very weak with the outer edges sometimes slightly apart. Color, rather brownish, upper edges being generally somewhat lighter. The surface sprinkled with apparently very fine particles of sand-like material. Exuviae subcentral and ringed with a whitish secretion. The exuviae also generally serve as the dorsal contact point with the bark while that portion of the ventral scale near the proboscis serves as the contact point with the bud. These scale insects are, furthermore, invariably attached at or very near the junction of a bud and branch.

*Associate Entomologist.

Adult female: Circular or slightly peg-top shaped, .4-.7 mm. in diameter. Pygidium (Fig. 11) with two pairs of lobes. Median pair rather short and very broad, chitinized, separated by about one-fifth the width of one of the lobes; inner margins slightly converging toward base; outer margins gradually receding to pygidial margin and crenulate. Second pair quite small, chitinized, projecting by about their own width; pointed. Plates apparently lacking between lobes. Each median lobe with a short spine at outer basal angle. Several long, slender spines just inside the margin beyond the second lobes. Two sets of three, long, slender, more or less bicuspidate plates on the margin beyond the position where the third lobe is missing. Paraphyses moderately developed and rather oblong-shaped. First pair between the first and second lobes and equal in length to slightly more than the width of one of the median or first pair of lobes. Second pair about one-third the length of the first pair of paraphyses and three times its own length from the first pair. Anal opening large, oval, with the basal portion on line with basal portions of the first pair of paraphyses. Comparatively few ducts. Circumgenital pores wanting. Chitinized "rods" and areas as in figure 11.

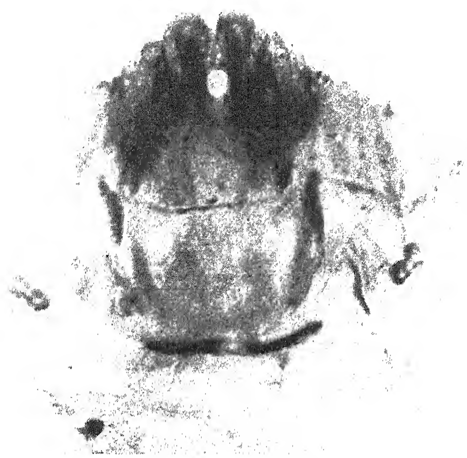

Fig. 11.—*Targionia quohogiformis* n. sp. Pygidium of adult. Greatly enlarged (original)

Male: Unknown.

Type material from blue trumpet (probably *Bignonia speciosa* Graham) collected by Mr. Jeff Chaffin, January 19, 1920, at Miami, Florida. (State Plant Board of Florida No. 6296.)

Plants found infested in Florida: Australian silk oak, blue trumpet, mountain ebony, queen's wreath *(Petraea volubilis)*, wild mulberry.

Additional plants found infested elsewhere: Croton, custard apple.

Distribution in Florida: Cocoanut Grove, Miami, Oneco and Palm Beach.

Distribution elsewhere: St. Lucie (British West Indies), and Santiago, Cuba.

Notes: Cotype slides have been deposited with the U. S. National Museum, Leland Stanford Junior University, Massachusetts Agricultural College, State Plant Board of Florida and the author's collection. I do not know of any species that this closely resembles and am placing it, tentatively, in this genus.

TWO NEW SPECIES OF MEALY-BUGS FROM FLORIDA

(Order: Hemiptera; Family: Coccidae)

BY JEFF CHAFFIN*

Recently Mr. Reginald Hart, Inspector of the State Plant Board, while making an entomological survey in the vicinity of Miami, collected a mealy-bug on lancewood which is apparently a new species. About the same time, Mr. Harry W. Fogg, Asst. Nursery Inspector of the State Plant Board, while inspecting a nursery in the vicinity of Lake Jem, discovered a mealy-bug attacking the roots of milk pea. This one also appears to be new.

After a careful search of available literature on the subject and failure to find descriptions corresponding to the character of the insects, specimens of both species were submitted to Prof. G. F. Ferris of Leland Stanford Junior University, California, who agrees that both species are new. These two mealy-bugs have therefore been classified as belonging to the genus Lachnodiella and Eriococcus respectively. Descriptions of each follow:

Eriococcus parvispinus n. sp.

Adult female: Enclosed in smooth, light yellowish, flattened, ovoid, felt-like sac. Female, when removed from sac, is dark wine colored and devoid of any cottony secretion. Abdominal segments very distinct; legs of a lighter color; body 2 mm. in length.

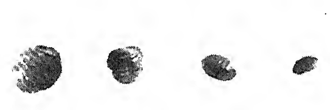

Fig. 12.—*Eriococcus parvispinus* n. sp. Greatly enlarged. (Photo by D. G. A. Chellberg).

The spines on the dorsum and those around the margin of the body are very few in number and of equal size and shape, being very small, broad at the base and tapering to a point. These spines are all arranged in definite, single rows, both longitudinally (6 rows) and transversely (about 12 rows). One of these transverse rows of six regularly spaced spines is present on each abdominal segment and the row curves with the segment. Anal lobes not chitinized, each with one large and two very small setae on the ventral side and four spines on the dorsal side. Of these four dorsal spines, one is the same size and shape of the body spines, one twice as long, very slender and curved, the other two small, straight and slender. The anal ring has 8 setae which are about one-fourth as long as anal lobe setae. Antennae 7-jointed. Legs small and slender, the claw with a tooth. A few ducts and pores scattered over entire body, being more numerous on abdominal segments; a group of pores and ducts around each spiracle.

Adult male: Small two-winged insect, body bright carmine in color, with four long, white, wax-like anal filaments. Legs and antennae yellowish red.

Male covering: Similar to female but much smaller.

Plants found infested in Florida: Milk pea *(Galactia volubilis)*.

Distribution in Florida: Lake Jem.

Note—Cotype slides deposited with Entomological Dept. State Plant Board of Florida.

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*Assistant Nursery Inspector.

Lachnodiella acritocera n. sp.

Adult female: From 3.5-4 mm. in length, grayish blue in color, broadly oval in shape, body covered with thin coating of fine powdery secretion. Broad, flat, rectangular-shaped waxy filaments around margin of body, becoming longer posteriorly, the anal pair being about one-fourth the length of the body.

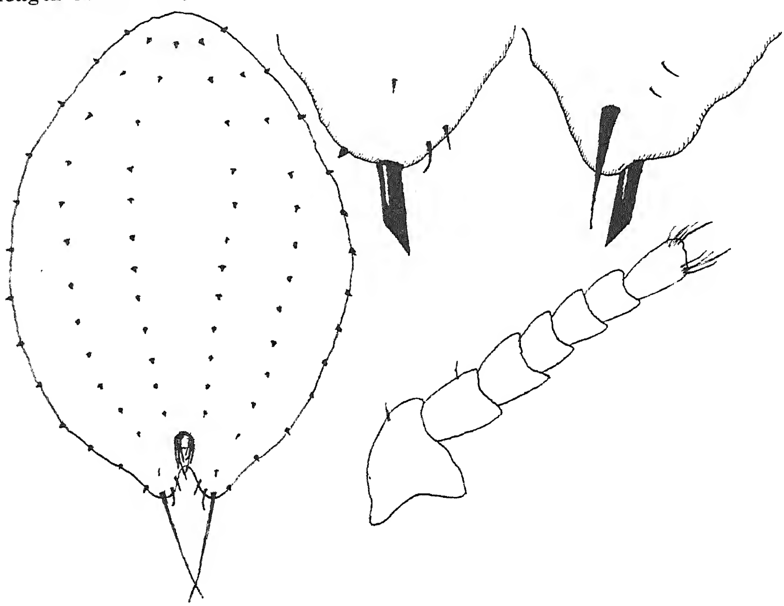

Fig. 13—*Eriococcus parvispinus* n. sp.: dorsal aspect of adult female; anal lobes, dorsal aspect left, ventral aspect right; antenna of adult female (Drawn by Miss Elita Lovejoy).

The number of pairs of cerarii is impossible to determine as some of them are very much divided. One pair indicated by 18 to 22 spines in each broken or rather irregularly divided group is on the head. The pair on the anal lobes and the penultimate pair are also in irregularly divided groups, each having 18 to 24 spines per group. Other pairs of cerarii are more irregularly divided, with accompanying spines scattered along margin of body in groups of from 1 to 10, forming an almost continuous row. All spines are conical in shape, accompanied by many triangular pores and cylindrical ducts. Ventral setae rather large and arranged in transverse rows, the setae being longer and more numerous on the head and near anal ring. One row of about 20 setae anterior of anal ring. Dorsal body setae short and slender. Anal lobes slightly protruded, with very slight

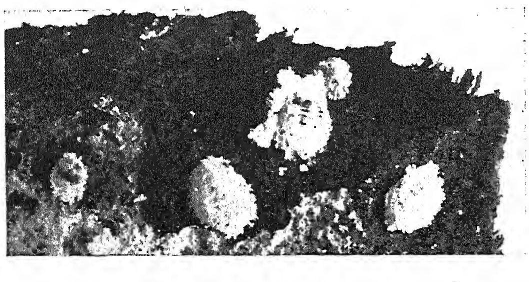

Fig. 14.—*Lachnodiella acritocera* n. sp. Greatly enlarged (Photo by D. G. A. Chellberg).

chitinized area on ventral side. Anal ring normal in size and more than twice its own diameter from posterior margin. Anal ring setae, 6 in number, a little longer than the diameter of the ring and about two-thirds as long as setae of anal lobe. Two setae nearly as long as anal ring setae are just anterior of anal ring. Dorsal osteoles prominent. Antennae 8-jointed. Claw without a tooth.

Male covering: Not observed.

Plants found infested in Florida: Lancewood *(Ocotea catesbyana.)*

Distribution in Florida: Miami.

Cotype slides deposited with Entomological Dept. State Plant Board of Florida.

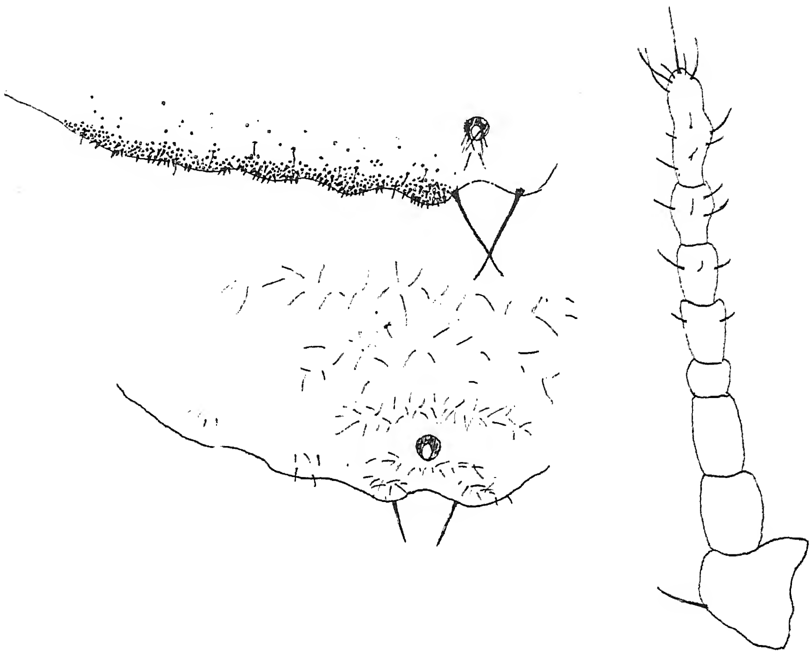

Fig. 15.—*Lachnodiella acritocera* n. sp.: Upper, dorsal aspect of posterior portion of abdomen, showing anal ring and cerarii; lower, ventral aspect, showing position of anal ring and ventral setae; right, antenna. (Drawn by Miss Elita Lovejoy).

Notes—This species is very similar to *Lachnodius phoradendri* (Ckll.) and *L. humboldtiae* Green. Morrison & Morrison in "Proceedings of U. S. Nat. Mus." Vol. 60, p. 47, have redescribed the type of the genus Lachnodius and have shown that neither of the above species rightfully belongs to this genus. They suggest that these species may possibly be transferred to the genus Lachnodiella and upon their suggestion, sanctioned by Prof. G. F. Ferris, the above species is placed in the genus Lachnodiella.

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*........*Editor*

ASSOCIATE EDITORS.

E. W. BERGER........*Entomologist*
F. M. O'BYRNE........*Nursery Inspector*
FRANK STIRLING........*General Inspector*
J. H. MONTGOMERY........*Quarantine Inspector*
O. F. BURGER........*Plant Pathologist*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

CREDIT WHERE CREDIT IS DUE. In our issue for October, 1922, there appeared an account of experiments which resulted in the development of an improved method of controlling the boll weevil. This publication attracted wide attention, both in this country and abroad, and the State Plant Board has been in receipt of many highly complimentary letters concerning the method of combating the weevil therein recommended. Perhaps the most marked recognition of the value of the article came from no less a person than the Honorable Secretary of Agriculture, Henry C. Wallace, who not only expressed appreciation of the value of the contribution but also officially designated the method as the "Florida Method of Boll Weevil Control".

As our readers have doubtless noted, the essence of the method consists in removing, by hand, all squares and, as far as possible, all boll weevils, from the cotton plants at the proper time—a date when practically all the over-wintering weevils have emerged from their hibernating quarters—and following this immediately with a single application of calcium arsenate to kill any weevils which might escape the hand picking.

In our editorial in the October issue we gave Mr. George D. Smith, Asssociate Entomologist of the Plant Board, credit for being the first investigator to see that an effective blow can be dealt the weevil at the time emergence from hibernation is complete; that, in fact, a critical period exists in the boll weevil's perpetuity at this time and can be taken advantage of with telling effect in the manner indicated. At the time this article was published, Mr. Smith, as well as the editorial staff of the Quarterly Bulletin, was not aware that a similar recommendation concerning the removal of all squares at the completion of the weevil's emergence from hibernation, had been made in Farmers' Bulletin 130 of the United States Department of Agriculture, by Professor F. W. Mally, at that time State Entomologist of Texas, published in 1901. It must be stated, in all frankness, that our Plant Board organization had assumed a familiarity with the boll weevil literature of past years which it did not in reality possess. It is a matter of surprise that, of all the entomologists who have read and studied the contribution by Mr. Smith, published in the October, 1922, Quarterly Bulletin, only one, seemingly, has discovered the omission regarding the work of Mally. At least only one has called our attention to it. We are deeply indebted to Professor R. W. Harned, State Entomologist of Mississippi, for having communicated to us his discovery of our failure to credit Mally with his recommendation with regard to square-picking and removal of weevils.

The recommendation made by Mally in 1901 is of particular interest in view of the importance which this type of square-picking now assumes as the most important single feature of the Florida method of weevil control. It is here quoted:

"A very effective method which can be resorted to with certainty of good results is that of actually picking off all the early squares which are produced before the cotton begins blooming. As has been noted, early in spring the weevils feed upon and among the terminal leaf buds before squares are developed. As soon, however, as these are produced the weevils take refuge in them and begin their ravages. As the squares are produced rather sparingly at first and the adults are found nowhere else, it is plain that practically the entire lot of weevils which withstood the winter may be collected and destroyed by this method, the important point being to delay this picking long enough to make sure that all living hibernating weevils have emerged.

"This process involves a slight loss of squares intended for early fruiting, but the advantage gained in the greater certainty of eradicating the pest early, and the consequent immunity of the squares set subsequently, more than offset the slight possible loss involved."

There can be no question but that Mr. Smith's own investigations led him directly to the conclusion that square picking at this stage of the cotton crop would prove an effective measure

against the weevil and there is no suspicion that his "idea" was secured from Mally's publication of twenty-two years ago. However, under the rules of priority as followed in scientific publications, credit for the inception of a measure or method goes to the individual who first publishes concerning it and in this case credit must be given to Mally for having been the first one to suggest, as a weevil control measure, the removal of all squares from the plants when all weevils have left their winter quarters. It may be remarked, parenthetically, that people not infrequently reach the same conclusion independently of each other and the coincidence just described is not at all surprising when it is remembered that many dozens of trained entomologists have given the weevil problem intensive study for many years.

It was unfortunate that the significance of Mally's recommendation in 1901 was not realized, either by entomologists or planters. Had it been, the boll weevil might have been shorn of much of his devastating ability long before this and several millions of dollars saved to the cotton growers and business interests of the South.—W. N.

QUARANTINE DEPARTMENT

Report on Inspections and Interceptions, All Ports and Stations, for the Quarter Ending March 31, 1923

Ships Inspected:		
From foreign ports	648	
From U. S. ports other than Florida	432	
From Florida ports	232	
Total		1,312
Number of Parcels Inspected:		
Arriving by water:		
Passed	217,648	
Treated and passed	27,793	
Returned to shipper	179	
Contraband destroyed	810	
Total		246,430
Arriving by land, express, freight, wagon, etc.:		
Passed	2,543½	
Treated and passed	117	
Returned to shipper	26	
Contraband destroyed	92½	
Total		2,779
Arriving by mail:		
Passed	439½	
Treated and passed	32	
Returned to shipper	32	
Contraband destroyed	5½	
Total		509
Grand Total of Parcels Inspected		249,718

Number of parcels on hand pending determination as to final disposition	40	
Total Parcels Passed	220,631	
Total Parcels Treated and Passed	27,942	
Total Parcels Returned to Shipper	237	
Contraband Destroyed	908	
Grand Total		249,718

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK IN COOPERATION WITH THE BUREAU OF PLANT INDUSTRY, FOR QUARTER ENDING MARCH 31, 1923

Citrus grove trees inspected	2,566,761
Citrus nursery trees inspected	22,764,694
Inspectors employed	92
Inspectors employed on canker eradication	50
New properties showing active infection	0
Total properties showing active infection	4
Grove trees found infected	4
Nursery trees found infected	0
Counties in which active infections were found	1

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	15,144
Nursery trees found infected since May, 1914	342,260
Number properties infected to March 31, 1923	509
Properties declared no longer "Danger centers"	486
Properties still classed as "Infected" Mar. 31, 1923	23

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to March 31, 1923:

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Jan.	....	306	86	14	0	0	0	0	0	1
Feb.	....	165	21	4	1	0	0	0	0	1
Mar.	....	444	49	9	1	1	0	0	0	2
April		408	49	169	2	1	0	0	0	....
May	.. 108	1042	338	52	1	1	0	0	585	....
June	160	772	450	45	10	0	0	0	168	....
July	275	651	349	39	0	0	539	0	28	....
Aug.	1313	1345	219	30	0	1	1	0	34	....
Sep.	767	618	124	6	0	0	0	0	23	....
Oct.	565	214	451	2	0	0	0	0	19	....
Nov.	773	494	131	1	0	0	0	0	12	....
Dec.	366	256	27	1	0	0	0	0	4	....
Total	4327	6715	2294	372	15	4	540	0	873	....

BEE DISEASE ERADICATION

REPORT FOR QUARTER ENDING MARCH 31, 1923

Number of apiaries inspected	174
Number of apiaries infected with American Foul Brood	2
Number of colonies inspected	4,907
Number of colonies infected with American Foul Brood	3
Number of apiaries infected with European Foul Brood	0
Number of colonies infected with European Foul Brood	0

THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. VII July, 1923 No. 4

SCALE-INSECTS OF FLORIDA

Order: Hemiptera. Family: Coccidae

By

G. B. Merrill*

and

Jeff Chaffin**

The purpose of this paper is to bring before the average reader an account of scale-insects which is not too technical in its nature and yet not so simple that it would mean little or nothing to future investigators of these insects. The authors are somewhat reluctant to attempt the production of such a paper, knowing fairly well the many difficulties which students of this group of insects have invariably encountered.

There is probably no other single group of insects that has received much more attention from the systematic and economic entomologists than the scale-insects. Furthermore, scale-insects, while generally quite small, may become very numerous and destructive to many plants, so that there is a continuous warring against them. Both the grower and the economic entomologist are constantly seeking means to control or eradicate one or another of the members of this group. The measures which have been found to be suitable are (1) artificial methods such as spraying or fumigation, (2) the use of some insect enemy, either predaceous or parasitic, (3) some one or more of the scale-destroying fungi, or diseases.

The losses and damage caused by scale-insects are only too well shown by the frequently poor quality and coloring of our fruits, by the unsightly discoloration of leaves, and by the loss of vitality and the not infrequent killing of trees and plants, both fruit and ornamental. The extraction of large quantities of plant juices for food by means of the sucking beaks of the scale-insects accounts mainly for these losses. On account of the puncturing of the plant tissues by means of the sucking beak, the way is also opened for the entrance of disease germs. Some scale-insects

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*Associate Entomologist.
**Assistant Nursery Inspector.

also produce a poisoning effect upon plants, the poison being introduced into the plant through the sucking beak. Still others excrete large quantities of honeydew, covering the infested plants with a thin layer of this sweet excretion, which results in the growth of a black mold sometimes seen covering fruit, leaves and stems, and spoken of as "sooty mold". This sooty mold, by cutting off the sunlight, interferes with the proper functioning of the leaves and the ripening or proper coloring of fruit. Concrete examples of such losses are those caused by the Purple, Long, Florida Red, Cottony Cushion, and Soft Brown Scales, and the whiteflies, all frequently found infesting citrus in Florida. The annual losses attributable to scale insects amount to hundreds of thousands of dollars in this state alone.

Other scale-insects, just as destructive but not yet known to be in Florida, are likely to be brought in on contraband, or even certified nursery stock, fruits, cut flowers, leaves, and similar material. Only by means of the utmost vigilance on the part of the horticultural authorities in Florida can we expect to keep such pests out of the state and country.

Relative to the literature on scale-insects of Florida, treated as a group, one finds only one paper, namely: "Some Florida Scale-insects", by Mr. C. E. Wilson,* published in the Quarterly Bulletin of the State Plant Borad of Florida, Vol. II, No. 1, October, 1917. Mr. Wilson gave brief descriptions, generally with illustrations, of the 84 species then listed by him as being in the state. Since the publication of the Wilson paper, many additional species have been collected and identified through the Entomological Department of the State Plant Board. This, together with the fact that the issue of the Quarterly Bulletin in which the Wilson contribution was published is about exhausted, has influenced the writers in preparing this paper. We include the material previously published by Wilson with certain revisions and corrections and add descriptions of the scale-insects subsequently found and classified.

The old arrangement of the descriptive matter under the several headings or groupings as follows: (a) Armored Scales, (b) Soft Scales, (c) Mealybugs, is, we believe, desirable. Descriptions of 70 species of armored scales, 26 species of soft scales, and 30 species of mealybugs found in Florida are given in this

*At that time Assistant Entomologist, State Plant Board of Florida.

paper. The bulk of the material presented under (c) Mealybugs, is the work of the junior author.

The host plants given under the different species are listed alphabetically rather than by degree of preference. The list of plants subject to injury should not be considered as complete. Only those plants are listed from Florida from which we have actually received the species listed, or of which we have authentic records in the literature of the groups.

Acknowledgment is hereby given to Mr. E. R. Sasscer, of the Federal Horticultural Board; to Mr. Harold Morrison, of the Bureau of Entomology, U. S. D. A.; and to Mr. G. F. Ferris, of the Leland Stanford University; for determining and verifying a number of the species listed herein; to Dr. H. T. Fernald, of the Massachusetts Agricultural College, for allowing the senior author the privilege of studying the type and authentic material on deposit in his department of the college; and last, but not least, to Mr. E. Ernest Green of England, author of "The Coccidae of Ceylon", etc., for the determination of specimens and sending us duplicate material for our collection. Except as otherwise indicated the photographic work included in this contribution is that of Mr. D. G. A. Chellberg, a student assistant in the College of Agriculture, University of Florida.

Classification

The Class Insecta (Insects) comprises one of the many classes, or larger groups, into which the Animal Kingdom is divided by investigators. The Insects are again subdivided into orders, some investigators listing as few as 8, while others classify them into many more.

The Scale-Insects, or Coccidae, belong to the Order Hemiptera. Examples of Hemiptera, besides scale-insects, are aphids, lace-bugs, electric-light bugs, Bed Bug, Squash Bug, the Cotton Stainer, and others known as stink bugs.

The Order Hemiptera is, furthermore, divided into two sub-orders: Heteroptera and Homoptera. The last named suborder (Homoptera) includes those families of insects commonly called whiteflies, scale-insects, aphids, leaf-hoppers, cicadas and others. The scale-insects constitute the family Coccidae.

Scale-insects may, without adhering too closely to the strictly technical viewpoint, be very conveniently classified under three

groups: (a) The Armored Scales, (b) the Soft Scales, and (c) the Mealybugs.

A. The Armored Scales

The Armored Scales are those which form a protective covering, called a scale, under which the female insect lives, feeds and remains fixed to the plant. This covering is formed as follows: In the female it is the product of the three successive stages of development, following the egg and culminating in the adult scale-insect. The first stage larva, after outgrowing its skin, forms a new one, ruptures and sloughs off the old skin, which then forms the nipple or first larval exuvia (Fig. 16 a and d). This exuvia covers the insect until it has passed through the second larval stage of its development. Meanwhile the second skin or covering, which had been developed under the first skin, has also become too small, ruptures and is cast off, forming the second larval exuvia (Fig. 16 b and e). The enclosed maturing insect then enlarges its home by secreting a tough covering (Fig. 16 d and f). This secreted covering, together with the two shed skins (exuviae) forms the scale, or scale-covering, of a scale-insect.

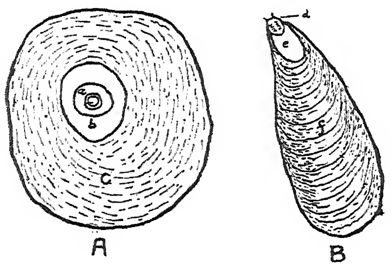

Fig. 16A.—Scale of female with exuviae central: a, first exuvia; b, second exuvia; c, secretionary covering.
Fig. 16B.—Scale of female with exuviae terminal: d, first exuvia; e, second exuvia; f, secretionary covering.

Figure 16 A shows the exuviae as central or subcentral (nearly central) with the secretionary portion around them and illustrates such as the Florida Red, San Jose, Dictyospermum and Latania Scales. Figure 16 B shows the exuviae as marginal or terminal with the secretionary portion extending behind them and illustrates such as the Purple, Long and Black Thread Scales.

The male forms its covering in the larval stages. The cast-off skin of the first stage larva forms the single exuvia which, together with a material secreted by the second stage larva, constitutes the scale covering or scale of the male. (Fig. 17 b, d and f).

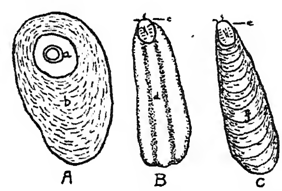

Fig. 17A.—Scale of male with exuvia sublateral: a, exuvia; b, secretionary covering.
Fig. 17B.—Scale of male with exuvia terminal: c, exuvia; d, secretionary covering.
Fig. 17C.—Scale of male with exuvia terminal: e, exuvia; f, secretionary covering.

There are three forms of male scales which indicate the group or genus to which they belong. Figure 17 A illustrates the male scale of the following genera: Aspidiotus, Chrysomphalus, Comstockiella, Gymnaspis, Odonaspis, Parlatoria, Pseudaonidia, Pseudischnaspis, Pseudoparlatoria and Targionia. Figure 17 B illustrates the males of such genera as Aulacaspis, Chionaspis, Diaspis, Fiorinia, Hemichionaspis, Leucaspis and Phenacaspis. Figure 17 C illustrates the males of the genus Lepidosaphes.

B. The Soft Scales

The Soft Scales, unlike the Armored Scales, do not secrete scale-like coverings that are free from the insect's body, but are either naked or more or less covered with a cottony, waxy, glassy, felty, powdery or frost-like secreted material. The scales in this group vary greatly in size and shape—some are flat or only slightly or moderately convex, others are highly convex or hemispherical, while a few are even spherical. Some are naked while others are partially or wholly covered or surrounded by a cottony, waxy, powdery or frost-like secretion. All Soft Scales possess the ability to crawl about during the younger stages of development. Some retain this longer than others.

Sex, in the Soft Scales, as well as in the Armored Scales, cannot be distinguished in the young larvae. Sooner or later, however, the male larvae begin to differentiate and may secrete glassy coverings within which they complete their development, finally emerging as minute two-winged, dainty, gnat-like insects.

C. The Mealybugs

For convenience we are listing under this heading several genera that could properly be placed in another group. Mealybugs do not form scale coverings like the Armored Scales and are not entirely naked like some of the Soft Scales. They are either partially or entirely covered with, or enclosed in, waxy, cottony or felt-like secretions.

The adult females are generally oval in shape and vary from 1.5 mm. to 6 mm. in length. They all have well developed legs and antennae (feelers) in the younger stages, and some members of the group retain these appendages and the power to move about throughout life.

The adult males are small two-winged insects and emerge from little cocoons or coverings which vary greatly in shape. In some

species the male coverings or cocoons are very numerous and noticeable, while in others they are not known.

It is impossible to give a popular description which will enable a person to recognize all species of this group, but from such popular descriptions one can identify the Common, Long-tailed and Coconut Mealybugs, and then by paying due attention to host plants, make a fairly accurate guess at the others. This statement applies with equal force to the other two groups treated of in this article, namely, the Armored Scales and the Soft Scales.

Mealybugs belong to a group of the Coccidae that, until recent years, has been slighted and given but vague, scattering and unrecognizable descriptions by even the best entomologists. Professor G. F. Ferris, in his admirable works on this group, has added materially to our knowledge, and by his clear-cut descriptions, given us the fundamental principles by which we can now better describe and recognize the different species.

The majority of the insects of this group are of relatively little economic importance. A few of them, however, are very serious pests. Members of this group resemble each other in appearance, and are therefore exceedingly difficult to identify. They are due serious consideration from an economic standpoint, in order that the more dangerous ones may be quickly and readily recognized.

Many insects that are of little or no economic importance in colder climates, may, when introduced into a tropical or subtropical climate such as Southern Florida possesses, become serious pests. Some of the mealybugs common in the North may be in that category.

The species herein described probably include all of the more injurious ones that occur in the State at the present time, but it is by no means a complete list of the mealybugs of Florida. The species described were either collected while doing serious damage or were so numerous as to attract attention, thus probably leaving many species less numerous or uncommon yet to be discovered.

Development and Metamorphosis

The young larvae of the Coccidae, whether newly hatched from eggs or born alive, like those of the San Jose Scale and some others, are of the same general appearance in both the male and the female and are frequently spoken of as crawlers

because they always move about. The male and female larvae remain alike during the first and second stages of their growth, and not until they reach the third stage do they begin to differ. Then it is that the male changes and gradually goes into the pupal or resting stage, from which, usually after a few days, it emerges as a minute, two-winged, gnat-like insect, without any mouth parts. The male insect lives only a few days for the purpose of fertilizing the female. The young female, on the other hand, continues her development in the same general form with which she started. She may lose her legs and feelers (antennae) or these may become reduced and rudimentary according to the rule in the group to which she belongs.

The development, or life history, of scale-insects differs from that of all other families in the Order Hemiptera in this respect: that the females alone develop according to the rule for Hemiptera. That is, they undergo incomplete metamorphosis, whereas the males undergo complete metamorphosis like most other insects. By metamorphosis is meant the successive changes which take place in the development of an insect after it leaves the egg. It is spoken of as "incomplete metamorphosis" when the young, or newly hatched, resemble the matured individuals, as has been previously indicated for the female scale-insect. Grasshoppers, in which the newly hatched resemble the mature hoppers, afford another instance of incomplete metamorphosis. In "complete metamorphosis", the young insect, as it leaves the egg, has hardly any resemblance to the adult form. This is illustrated by the male scale-insect previously discussed. Moths and butterflies, which hatch as caterpillars, are also illustrative of this.

How Scale-Insects Feed

The beak or proboscis (mouth-parts) of scale-insects is a more or less elongated tube which is inserted into some part of the plant in order to suck its juices. Some scale-insects are able to withdraw the beak for the purpose of changing their location on the plant, while others, having once inserted the mouth-parts into the plant, remain stationary for the duration of their lives.

The fact that scale-insects have mouth-parts by means of which they extract plant juices from beneath the surface or skin of plants and fruits makes it impossible to destroy them by means of stomach poisons, such as the arsenicals, but other means of control must be devised (See section on Control).

CONTROL*

Were it not for natural enemies the scale-insects would practically destroy the horticultural industry of Florida in a very few years. This statement is made advisedly notwithstanding the fact that a fair degree of control may be obtained through artificial means, for if the producer were dependent solely upon the latter the expense would be excessive and the results inadequate. The natural enemies of scale-insects are two kinds (a) parasitic fungi, or diseases, which attack and destroy certain insects and (b) other insects, predaceous and parasitic, which prey upon the scale-insects. An illustration of the former is the Red-Headed Scale-Fungus which affects a number of scale-insects. Of predaceous insects, the lady-beetles are a good example. These natural enemies, after they become firmly established, hold the scale-insects in check to such an extent that it is possible, in many localities, to grow good fruit and ornamentals without any spraying or other control measures. It is, of course, necessary to use control measures when the fungi, lady-beetles, etc. are not present in large numbers, and it is nearly always necessary to do something additional in the nature of control, if we expect to produce the maximum quantity of first-grade fruit.

In Florida, fumigation not being practicable, the next best control measure, in fact the only one we can rely on to control scale-insects when the natural enemies fail, is spraying. Dusting with finely powdered sulphur is a method frequently used in the control of Rust Mite and red spider, but as these are not scale-insects we will not further discuss this method. To obtain the best results from spraying, one must spray at the proper time and use the proper insecticide, applying it correctly. The insecticides employed against scale-insects are known as contact insecticides, and are different from stomach poisons, which are used against insects that eat leaves, etc., in other words, chew their food. Scale-insects, having a sucking beak, thrive or subsist on plant juices which they suck, and cannot therefore be killed by an internal or stomach poison. Obviously, a contact spray will kill only those insects which it hits. Therefore, thoroughness in covering all infested parts of a plant is absolutely essential.

*For more detailed information regarding sprays and spraying the reader is referred to the article on "Control of Scale-Insects", by E. W. Berger, Volume II, No. 1, Quarterly Bulletin, October, 1917; Bulletin 30, Agricultural Extension Division, University of Florida, September, 1921, "A Spray Schedule for Citrus"; and to Bulletin 148, Florida Agricultural Experiment Station, "Insects of a Citrus Grove", by J. R. Watson.

Spraying is one of the best paying investments horticulturists can make if their plants are infested with scales, provided they spray at the right time and with the proper materials. To accomplish this, we must be able to correctly identify the insect in question and also have some knowledge of its life history or habits. It is impossible to kill all scale-insects at one spraying, but generally, when necessary, or when the natural enemies are not sufficiently effective in keeping the insects under control, from one to three good sprayings each year will reduce their numbers very materially. No hard and fast rule can be laid down with respect to the number of sprayings per year. Conditions vary greatly according to location, climate, degree of infestation, etc. For instance, in hammock groves where wholly ideal conditions exist for the growth of fungi one spraying in October may be sufficient, or even may be omitted. As a general proposition, it can be stated that the October application of an insecticide is strongly recommended for the control of both scales and whiteflies.

The various friendly fungi (fungus parasites attacking insects) are the most formidable natural enemies of the majority of the injurious scales; therefore, care should be used in selecting a spray material that will not injure any of these friendly fungi. All of these fungi are easily killed when a fungicide, such as bordeaux mixture, is used. It is advisable, therefore, not to use a fungicide unless it is actually necessary. When scab, melanose or other fungus diseases necessitate the use of bordeaux on scale-infested plants, an oil emulsion should be added so that there will be 1% of oil in the spray which is applied. This is known as bordeaux-oil spray. Bordeaux-oil spray is more lasting as a fungicide than as an insecticide. For this reason, bordeaux-oil spray should be used as a fungicide and not as an insecticide or general spray. After bordeaux-oil has been used, the plants should be watched carefully and should be sprayed thoroughly with an oil emulsion alone as soon as young scales (crawlers) begin to appear in considerable numbers. This spraying must not be deferred until the scale-insects have reached maturity and are protected by a hard scale covering. An insecticide properly applied to young scales will kill all of those with which it comes in contact. The same spray will kill but fifty to seventy-five percent of the adult scales and the mortality in the egg stage will be even smaller. If bordeaux is used without the addition of oil emulsion, the scale-insects will increase with such rapidity that

serious damage will result in a very short time. In such a case, it will be necessary to make use of several applications of some strong insecticide, whereas one application is sufficient following bordeaux-oil if used at the proper time. Lady-beetles and some of the other beneficial insects do not necessarily meet with the fate of the friendly fungi when bordeaux is used, as many of them in the adult stages are capable of flying away, thus avoiding the spray.

The kind of insecticide, as well as the strength to be used, depend on the host plant and climatic conditions, as well as the insect. For example, lime sulphur applied at the rate of 1 to 9, during the dormant period (when trees are without foliage), is one of the best insecticides to use in the control of San Jose Scale on peach and other deciduous trees, but it would not do to use so strong a solution on citrus or any other tender plants, especially those of a subtropical or tropical nature, even if they were infested with the same insect. Oil sprays of a strength which, when applied to a citrus grove in the summer months, will cause considerable injury, may be used in the fall and winter months without damage.

The control of scale-insects will be discussed by groups as previously listed, viz.: Armored scales, Soft Scales and Mealybugs.

Armored Scales

The most important members of this group, from an economic standpoint, are Purple, Chaff, Florida Red and Long Scales on citrus; San Jose and Latania Scales on deciduous trees; and Dictyospermum Scale on the avocado and other subtropical and tropical plants. The above arrangement does not mean that Purple Scale attacks citrus only or that San Jose Scale occurs on deciduous trees only, but is an arrangement largely for convenience

Scale-Insects Infesting Citrus

Purple Scale is the most widely distributed and probably does more damage to the citrus industry of the state than any other insect. Then naturally more spraying must be done for its control. A spraying program which successfully controls this insect will take care of any other scale-insects present in a citrus grove, as well as whitefly, with the possible exception of the Florida

Red Scale, which, on account of its resistant covering, sometimes requires a stronger solution and an additional application. It is hard to set any definite time to spray, as the particular locality, weather conditions, friendly fungi present and degree of scale infestation are important factors. Generally speaking, one good spraying a year, preferably in October, should be sufficient to handle the average infestation. Severe infestations may of course require additional sprayings. More effective results are obtained if the insecticide is applied when there are a large number of crawlers and young scales present. At this time a weak solution of insecticide is more effective than a strong spray solution when the insects are in the adult stage. If possible, it is best to time spraying so as to take care of the whitefly also. In October, the last brood of crawlers is present and during this month is generally the best time to spray. By aid of a small hand lens a grower can detect the small yellowish crawlers and by spraying promptly when they are observed in numbers make his spraying most effective. Spraying during the period of summer rains is generally a waste of time and money as the insecticide may be washed off before it has had time to become effective.

The material used should consist of some good oil emulsion insecticide or miscible oil. Fish-oil soap is also a good contact insecticide and is often added to spray solutions to soften the water and keep the oil from rising to the top. This is only necessary when soft water is not available. If the water is not softened before the oil is added a good mixture is not secured and severe injury may result. There are on the market, however, several good commercial hard water insecticides which carry their stabilizer and will mix with most hard waters very successfully.

Scale-Insects Infesting Deciduous Trees

San Jose Scale is the most widely distributed and, as a whole, probably the most injurious scale-insect in the United States. Fortunately, it does not attack citrus, with the exception of *trifoliata*. Its preferred hosts—peach, pear, plum and apple—are not grown very extensively in this state so it is not of as much economic importance as some of the citrus insects. Best results in the control of San Jose Scale infesting deciduous plants are obtained by the use of a strong solution of lime sulphur at the rate of about 1 to 9 applied during the dormant season. This treatment will also, generally, take care of any other Armored

Scales on deciduous plants. Where only a few plants are infested with San Jose Scale, it is probably best to destroy them and prevent the spread of the insect.

Scale-Insects Infesting Avocados and Other Plants

During the last few years, Dictyospermum Scale has become the most serious insect pest of the avocado and some other plants in the southern part of this state and at the present time is of considerable economic importance, due to the fact that it has become established in comparatively recent years and there are not enough natural enemies present to hold it in check. It may be controlled by the use of soap or oil sprays as strong as the plant will stand without burning.

SOFT SCALES

While some of the Soft Scales present in Florida are quite effectively controlled by their natural enemies, either fungi or insects, others do occasionally so severely infest their host plant that the use of artificial control measures becomes necessary. The Black Scale is a very serious pest in California and at times necessitates the fumigation of citrus groves. This scale is widely distributed in Florida but is so completely controlled by its natural enemies that even its presence is rarely observed by the average grower. Most of the Soft Scales are comparatively large in size and excrete a great deal of honeydew, in which a fungus commonly called sooty mold develops, frequently resulting in the unsightly appearance of the infested plant. This is very noticeable and causes one to think serious damage is being done.

Perhaps the most injurious members of this group, which we have to contend with in Florida, are the Pyriform Scale and Green Shield Scale. These scales are hardest to control and seem to have fewer natural enemies. The eggs of both are protected by a mass of cottony secretion in which they are deposited. This secretion is not readily penetrated by a spray solution and naturally calls for the use of as strong a solution of oil or soap insecticide as the plant will stand. If the infestation is severe, two or three sprayings at intervals of two or three weeks may be necessary. Other members of this group may generally be controlled with but one application of a good insecticide.

MEALYBUGS

Members of this group are by far the most difficult to control by artificial means. The waxy covering which most of them possess is hard to penetrate with any insecticide. The U. S. Bureau of Entomology and the California Experiment Station after years of experimenting in the control of Baker's Mealybug (This species has recently been collected in Florida) can recommend no satisfactory method. The best they can do is to offer recommendations for preventing its distribution. So far, the most important insects of this group that we have to deal with in this state, from an economic standpoint, are the Common, Long-Tailed, Coconut and Pineapple Mealybugs. The best that we can offer for their control is to spray with as strong a solution of oil emulsion as the host plant will stand without being injured.

Quite recently there has been noticed a gray fungus, invisible to the naked eye, that preys on this group. Let us hope that in a few years we may be able to distribute cultures of this friendly fungus, as the Entomological Department of the State Plant Board is doing in the case of the Red and Yellow Aschersonias which attack whiteflies.

Cottony Cushion-Scale is widely distributed through the peninsular part of Florida. It is so conspicuous in appearance and is accompanied by so much sooty mold that growers become greatly alarmed over its presence. Its eggs are embedded in a thick cottony mass which protects them from an insecticide. Were it not for a natural enemy, the Vedalia, this scale would be one of our very worst pests. However, it is an insect of rather minor importance for it is held under perfect control by the Vedalia, or Australian Lady-Beetle. After the Vedalia is once established in a community, it generally remains. Occasionally, however, the Vedalia disappears and does not reappear when needed. In such a case, another start may be secured from the State Plant Board as the collecting, raising and distribution of Vedalia is one of the projects of the Entomological Department.

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Explanation of Terms Used

Alveolate=deeply pitted.

Anal cleft=the split from margin to anal opening.

Anal lobes=a pair of small, triangular, hinged processes on the upper surface of soft scales which form a valve that covers the anal parts.

Anal plates=see anal lobes.

Apical=at the apex or head-end.

Carina=an elevated ridge, not necessarily high or acute; plural carinae.

Carinate=having ridges.

Chitin=a material forming the hardened parts of the bodies of insects.

Caudolateral=on the hind margin.

Cephalolateral=on the front margin.

Cosmopolitan=occurring throughout most of the world.

Cotype=one of several insects or slides from which the insect was originally described.

Dorsal=upper surface of insect or of scale covering; back.

Exuvia (singular)=a cast larval skin which is incorporated in the scale covering (See figure 16A & B and 17A, B & C).

Exuviae (plural)=the two cast larval skins which are incorporated in the scale covering of most female Armored Scales (See figure 16A & B).

Habitat=region or place that an insect inhabits or where it was collected.

Hypopygial=anal.

Hypopygium=pertaining to the vent or anus.

Marginal=at or touching the margin.

Oviparous=where reproduction is by means of eggs.

Sp.=species (Singular)=one particular kind of plant, not specified, of a genus.

Spp.=species (Plural)=two or more kinds of plants, not specified, of the same genus.

Subapical=near the apex or head end.

Subcentral=just outside the central portion.

Subequal=similar but not quite equal in size.

Sublateral=away from central portion toward one end or the other.

Submarginal=close to the margin.

Subparallel=nearly parallel.

Taxonomic=pertaining to classification.

Terminal=at or extending beyond the end.

Topotype=is a specimen which was collected at the exact locality from which the species was originally collected.

Tropicopolitan=occurring in all tropical regions.

Ventral=lower surface between the insect and the plant.

Viviparous=giving birth to living young.

Arrangement of the Groups

The Family Coccidae, or Scale-Insects, is one of the group of families that constitute the Suborder Homoptera in the Order Hemiptera. The Family Coccidae is represented in Florida by seven subfamilies as follows (arranged according to Fernald):

Monophlebinae (Genera: Palaeococcus and Icerya)

Margarodinae (Genus: Margarodes)

Ortheziinae (Genus: Orthezia)

Conchaspinae (Genus: Conchaspis)

Dactylopiinae (Genera: Asterolecanium, Lecaniodiaspis, Kermes, Eriococcus, Dactylopius, Phenacoccus, Lachnodiella, Trionymus, Pseudococcus, and Antonina)

Coccinae (Genera: Pulvinaria, Pseudophilippia, Ceroplastes, Inglisia, Eucalymnatus, Coccus, Neolecanium, Toumeyella, Saissetia and Lecanium)

Diaspinae (For genera in this subfamily, see list of Armored Scales following.) Note also that, since there is only one subfamily (Diaspinae) to represent the Armored Scales, these two terms become synonymous.

These seven subfamilies have, for convenience, been arranged in three groups: The Armored Scales, the Soft Scales and the Mealybugs. Included within one or the other of the two last named groups may also be found members of one or more of the subfamilies that might more properly have been assigned to a separate and distinct group of its own. For the sake of simplicity, however, this has not been done.

The Armored Scales, as already indicated in the second preceding paragraph, are synonymous with Diaspinae and comprise all genera (a genus, plural genera, is the next subdivision of a family or subfamily) in that subfamily and, in Florida, are represented by twenty-two: Chionaspis, Howardia, Diaspis, Aulacaspis, Phenacaspis, Hemichionaspis, Pinnaspis, Leucaspis, Fiorinia, Aspidiotus, Cryptophyllaspis, Comstockiella, Pseudaonidia, Chrysomphalus, Pseudischnaspis, Targionia, Odonaspis, Pseudoparlatoria, Gymnaspis, Lepidosaphes, Ischnaspis and Parlatoria.

The Soft Scales are represented in Florida by the subfamily Coccinae, which includes the following ten genera: Pulvinaria, Pseudophilippia, Ceroplastes, Inglisia, Eucalymnatus, Coccus, Toumeyella, Saissetia, Lecanium and Neolecanium.

The Mealybugs are represented in Florida by the valid subfamily Dactylopiinae which includes the following ten genera: Asterolecanium, Lecaniodiaspis, Kermes, Eriococcus, Phenacoccus, Lachnodiella, Trionymus, Pseudococcus, Antonina and Dactylopius. Other subfamilies and genera placed in this group for convenience are as follows:

Subfamily Monophlebinae, genera Palaeococcus and Icerya.
Subfamily Margarodinae, genus Margarodes.
Subfamily Ortheziinae, genus Orthezia.
Subfamily Conchaspinae, genus Conchaspis.

List of the Florida Species

A. Armored Scales (Pages 197-254)

1. Aspidiotus *abietis* Comst. (Hemlock Scale)
2. *Aspidiotus ancylus* (Put.) (Putnam's Scale)
3. *Aspidiotus coursetiae* Marl.

4. *Aspidiotus cyanophylli* Sign. (Cyanophyllum Scale)
5. *Aspidiotus destructor* Sign.
6. *Aspidiotus forbesi* Johnson (Cherry Scale)
7. *Aspidiotus hederae* (Vall.) (Ivy Scale)
8. *Aspidiotus juglans-regiae* Comst. (English Walnut Scale)
9. *Aspidiotus lataniae* Sign. (Latania Scale)
10. *Aspidiotus orientalis cocotiphagus* Marl.
11. *Aspidiotus osborni* Newell & Ckll.
12. *Aspidiotus perniciosus* Comst. (San Jose Scale)
13. *Aspidiotus pini* Comst.
14. *Aspidiotus pseudospinosus* Woglum
15. *Aspidiotus rapax* Comst. (Greedy Scale)
16. *Aspidiotus spinosus* Comst.
17. *Aspidiotus subsimilis anonae* Houser
18. *Aspidiotus uvae* Comst. (Grape Scale)
19. *Aulacaspis rosae* (Bouche) (Rose Scale)
20. *Chionaspis americana* Johnson (Elm-tree White Scale)
21. *Chionaspis caryae* Cooley
22. *Chionaspis citri* Comst. (Snow Scale)
23. *Chionaspis euonymi* Comst. (Euonymus scale)
24. *Chionaspis pinifoliae* (Fitch) (Pine-leaf Scale)
25. *Chionaspis pinifoliae heterophyllae* Cooley (Pine Scale)
26. *Chionaspis quercus* Comst.
27. *Chionaspis salicis-nigrae* (Walsh) (Willow Scale)
28. *Chionaspis sylvatica* Sanders
29. *Chrysomphalus aonidum* (Linn.) (Florida Red Scale)
30. *Chrysomphalus aurantii* (Mask.) (California Red Scale)
31. *Chrysomphalus aurantii citrinus* (Coq.) (Yellow Scale)
32. *Chrysomphalus dictyospermi* (Morg.) Dictyospermum Scale)
33. *Chrysomphalus mimosae* (Comst.) (Mimosa Scale)
34. *Chrysomphalus obscurus* (Comst.) (Obscure Scale)
35. *Chrysomphalus perseae* (Comst.) (Red Bay Scale)
36. *Chrysomphalus tenebricosus* (Comst.) (Gloomy Scale)
37. *Comstockiella sabalis* (Comst.) (Palmetto Scale)
38. *Cryptophyllaspis liquidambaris* Kot. (Sweet Gum Scale)
39. *Diaspis boisduvalii* Sign. (Boisduval's Scale)
40. *Diaspis bromeliae* (Kern.) (Pineapple Scale)
41. *Diaspis echinocacti cacti* Comst. (Cactus Scale)
42. *Diaspis pentagona* (Targ.) (White Peach Scale)
43. *Fiorinia fioriniae* (Targ.) (European Fiorinia)
44. *Fiorinia theae* Green (Tea Scale)

45. *Gymnaspis aechmeae* Newstead
46. *Hemichionaspis aspidistrae* (Sign.) (Fern Scale)
47. *Hemichionaspis minor* (Mask.) (Lesser Snow Scale)
48. *Howardia biclavis* (Comst.) (Mining Scale)
49. *Ischnaspis longirostris* (Sign.) (Black Thread Scale)
50. *Lepidosaphes alba* (Ckll.)
51. *Lepidosaphes beckii* (Newm.) (Purple Scale)
52. *Lepidosaphes camelliae* Hoke (Camellia Scale)
53. *Lepidosaphes dentata* (Hoke)
54. *Lepidosaphes gloverii* (Pack.) (Long or Glover's Scale)
55. *Lepidosaphes hawaiiensis* (Mask.)
56. *Lepidosaphes ulmi* (Linn.) (Oyster-shell Scale)
57. *Leucaspis bambusae* Kuw.
58. *Leucaspis indica* Marlatt (Mango Scale)
59. *Odonaspis ruthae* Kotinsky (Bermuda Grass Odonaspis)
60. *Parlatoria pergandii* Comst. (Chaff Scale)
61. *Parlatoria proteus* (Curtis)
62. *Phenacaspis nyssae* (Comst.) (Sour-Gum Scale)
63. *Pinnaspis buxi* (Bouche)
64. *Pseudaonidia articulatus* (Morg.) (Rufous Scale)
65. *Pseudaonidia tesserata* (de Charm.)
66. *Pseudischnaspis alienus* (Newst.) (Alien Scale)
67. *Pseudoparlatoria parlatorioides* (Comst.) (Parlatoria-like Scale)
68. *Targionia dearnessi* (Ckll.)
69. *Targionia quohogiformis* Merrill (Quohog-shaped Scale)
70. *Targionia sacchari* (Ckll.) (Sugar-cane Scale)

B. Soft Scales (Pages 254-275)

1. *Ceroplastes ceriferus* (And.) (Japanese Wax Scale)
2. *Ceroplastes cirripediformis* Comst. (Barnacle Scale)
3. *Ceroplastes floridensis* Comst. (Florida Wax Scale)
4. *Coccus acuminatus* Sign. (Acuminate Scale)
5. *Coccus elongatus* Sign. (Long Soft Scale)
6. *Coccus hesperidum* (Linn.) (Soft Brown Scale)
7. *Coccus mangiferae* (Green) (Mango Shield Scale)
8. *Coccus pseudohesperidum* (Ckll.)
9. *Eucalymnatus tessellatus* (Sign.) (Tessellated or Palm Scale)
10. *Inglisia vitrea* Ckll.
11. *Lecanium corni* (Bouche) (European Fruit Lecanium)
12. *Lecanium nigrofasciatum* (Perg.) (Terrapin Scale)

13. *Lecanium persicae* (Fab.) (Peach Lecanium)
14. *Lecanium quercifex* Fitch (Oak Lecanium)
15. *Neolecanium cornuparvum* (Thro) (Magnolia Soft Scale)
16. *Pseudophilippia quaintancii* Ckll. (Cottony Pine Scale)
17. *Pulvinaria psidii* Mask. (Green Shield Scale)
18. *Pulvinaria pyriformis* Ckll. (Pyriform Scale)
19. *Pulvinaria urbicola* Ckll.
20. *Pulvinaria vitis* (Linn.) (Cottony Maple Scale)
21. *Saissetia hemisphaerica* (Targ.) (Hemispherical Scale)
22. *Saissetia nigra* (Nietn.)
23. *Saissetia oleae* (Bern.) (Black Scale)
24. *Toumeyella liriodendri* (Gmel.) (Liriodendron Scale)
25. *Toumeyella parvicornis* (Ckll.)
26. *Toumeyella turgida* (Ckll.)

C. Mealybugs (Pages 276-298)

1. *Asterolecanium bambusae* Bdv. (Bamboo Scale)
2. *Asterolecanium miliaris longum* (Green)
3. *Asterolecanium pustulans* (Ckll.) (Pustule Scale)
4. *Conchaspis angraeci* Ckll.
5. *Dactylopius confusus* (Ckll.) (Cottony Cochineal)
6. *Eriococcus azaleae* Comst. (Azalea Eriococcus)
7. *Eriococcus quercus* (Comst.) (Oak Eriococcus)
8. *Eriococcus parvispinus* Chaffin
9. *Icerya purchasi* Mask. (Cottony Cushion-Scale)
10. *Kermes galliformis* Riley
11. *Kermes kingii* Ckll.
12. *Kermes pettiti* Ehrh.
13. *Lachnodiella acritocera* Chaffin
14. *Lecaniodiaspis tessellata* Ckll.
15. *Margarodes formicarium* Guild.
16. *Margarodes rileyi* Giard.
17. *Orthezia insignis* Dougl. (Greenhouse Orthezia)
18. *Palaeococcus rosae* (R. & H.) (Rose Palaeococcus)
19. *Phenacoccus colemani* Ehrh.
20. *Phenacoccus saloni* (Ckll.)
21. *Pseudococcus bromeliae* (Bouche) (Pineapple Mealybug)
22. *Pseudococcus citri* (Risso)
23. *Pseudococcus comstocki* Kuw. (Comstock's Mealybug)
24. *Pseudococcus juniperi* Ehrh.
25. *Pseudococcus longispinus* (Targ.) (Long-tailed Mealybug)
26. *Pseudococcus maritimus* (Ehrh.) (Baker's Mealybug)

27. *Pseudococcus nipae* (Mask.) (Coconut Mealybug)
28. *Pseudococcus virgatus* (Ckll.)
29. *Trionymus calceolariae* (Mask.) (Sugar-cane Mealybug)
30. *Trionymus quaintancii* (Tinsley)

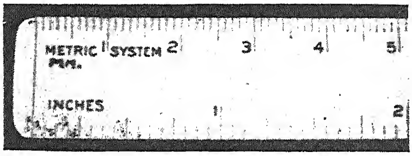


Fig. 18.—Upper divisions in millimetres, lower in inches.

A. The Armored Scales

1. *Aspidiotus abietis* (Schr.) (Hemlock Scale)

"Scale of Female: The scale of the female is from 1/20 inch to 2/25 inch (1.3 mm. to 2 mm.) in length. The scale is elongated and the sides are almost parallel, the ends being rounded. The exuviae is orange color and the color of the scale is dark gray or black with the margins lighter.

Scale of Male: The scale of the male is similar to that of the female, but is smaller and slightly darker.

Plants found infested in Florida: short leaf pine.

Other plants liable to become infested: fir; hemlock; maple; pines.

Distribution in Florida: West Palm Beach."

Distribution elsewhere: California, Georgia, Maine, Massachusetts, New York, New Jersey; Europe.

Remarks: One record for Florida by C. E. Wilson. The above quoted description is by Wilson, in Quarterly Bulletin, State Plant Board, Vol. II, No. 1, 1917. We have no specimens on file.

2. *Aspidiotus ancylus* (Put.) (Putnam's Scale)
(Fig. 19)

Scale of female: Approximately circular; varying from 1-1.5 mm. in diameter. Color dark gray, sometimes almost black, margin somewhat lighter. The exuviae are brick-red, covered with a grayish or lighter colored secretion.

Scale of male: Similar to that of the female but smaller and more elongate.

Plants found infested in Florida: Blueberry, chestnut, oak, peach, pecan, persimmon (wild) and walnut.

Additional plants found infested elsewhere: Apple, ash, beech,

bladdernut, cherry, currant, elm, gooseberry, hackberry, hawthorn, hickory, linden, locust, maples, osage orange, peas, plum, quince, snowball, tulip and willow.

Distribution in Florida: Archer, Campville, Cottage Hill, Daytona, Fort Pierce, Gainesville, Glen St. Mary, Jacksonville, Mims, Macclenny, Monticello, Oldsmar, Pensacola, Sutherland and Tallahassee.

Fig. 19. — *Aspidiotus ancylus* (Put.) (Putnam's Scale) Enlarged. (After Douglas.)

Distribution elsewhere: California, Colorado, Connecticut, Delaware, District of Columbia, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, New Jersey, New Mexico, New York, Ohio, Pennsylvania, South Dakota, Texas, Vermont, Virginia, Washington; Canada, Germany.

Remarks: Not known to be of much economic importance at present.

3. *Aspidiotus coursetiae* Marl.

Scale of female: Approximately circular, although irregularly so when found upon rough bark. It is from 1.25-1.75 mm. in diameter. Color (Florida specimens) grayish yellow. Exuviae orange colored, more or less central. Scale usually covered with whitish incrustations of the bark.

Scale of male: Similar to that of the female but a trifle smaller and more elongate.

Plants found infested in Florida: Pigeon plum *(Coccolobis laurifolia* Jacq.).

Additional plants found infested elsewhere: *Coursetia glandulosa.*

Distribution in Florida: Miami.

Distribution elsewhere: Mexico.

Remarks: The specimens collected in Florida appear to differ slightly in some respects from the type material filed in Washington with which it was compared by Morrison. It is not impossible that further study will indicate these Florida specimens to be either a variation from type or to belong to another species.

4. *Aspidiotus cyanophylli* Sign. (Cyanophyllum Scale)
(Fig. 20)

Scale of female: Generally of an elongated ovate shape, or triangular with points bluntly rounded when situated at a fold or along a vein on the under surface of the leaf. Its greatest diameter, or longest dimension when triangular, is from 1-2.25 mm. The scales are very thin, flat, more or less transparent, the yellow body of the insect showing through. The exuviae are central, yellow in color, and covered with a light colored secretion.

Fig. 20.—*Aspidiotus cyanophylli* Sign. (Cyanophyllum Scale) Reduced.

Scale of male: Similar to that of the female, smaller and more elongate. Exuvia subcentral.

Plants found infested in Florida: Acalypha, *Anona* sp., avocado, banana, bay, begonia, *Billbergia thyrsoidea, Bougainvillea* sp., coffee plant, *Cycas* sp., fig, guava, *Hernandia bivalvis,* honesuckle, ivy, Jamaica apple, jasmine, *Ligustrum* sp., loquat, magnolia, mountain ebony, pandanus, palms, pittosporum and plumeria.

Additional plants found infested elsewhere: *Cinchona* sp., *Cyanophyllum* sp., *Eucalyptus* sp., *Ipomoea* sp., *Laurus* sp., *Miconia magnifica,* mistletoe, moonflower, orchids, *Pritchardia filifera* and tea.

Distribution in Florida: General.

Distribution elsewhere: Alabama, California, Connecticut, District of Columbia, Illinois, Indiana, Kansas, Massachusetts, Mississippi, New Jersey, New York, Ohio, South Carolina; Bahamas, Brazil, Canary Islands, Central America, Ceylon, Cuba, England, Fiji, France, Italy, Mauritius, Mexico, Seychelles, Uganda Protectorate, Zanzibar.

Remarks: Occasionally becomes a serious pest on avocado.

5. *Aspidiotus destructor* Sign.

(Fig. 21)

Scale of female: Approximately circular, thin, transparent, and from 1.75-2 mm. in diameter. Color faint yellow. Exuviae central or subcentral, pale to deep yellow.

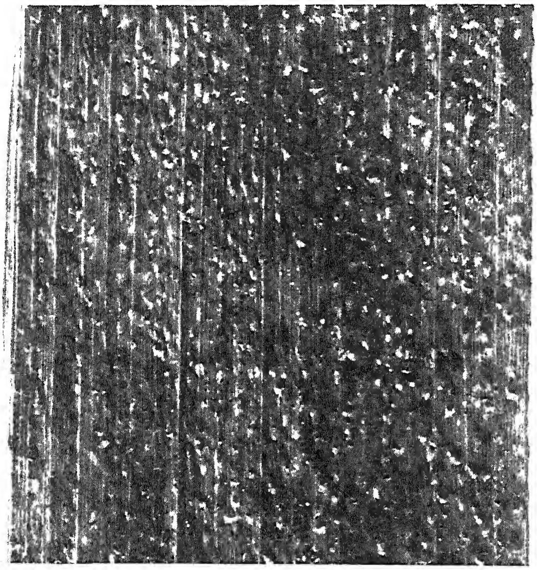


Fig. 21.—*Aspidiotus destructor* Sign. Enlarged.

Scale of male: Shape oval-oblong, smaller than that of the female. Color faint yellow. Exuvia rather subcentral.

Plants found infested in Florida: Banana, mango, palms (Chinese fan, coconut and date).

Additional plants found infested elsewhere: Almond, banana, castor bean, *Celtis occidentalis*, guava, nutmeg, palms, silk oak *(Grevillea robusta)*, sugar cane, *Terminalia catappa*, traveler's tree, etc.

Distribution in Florida: Key West, Miami and Oneco.

Distribution elsewhere: Africa, Bourbon Island, British Guiana, Ceylon, China, Cuba, Demerara, Dutch East Indies, Dutch Guiana, Fiji, Formosa, France, Grenada, Guam, India, Isle of Pines, Italy, Jamaica, Laccadive Islands, Mauritius, Mexico, Nigeria, Philippine Islands, Porto Rico, St. Vincent, South Africa, Tahiti, Tobago, Trinidad, Uganda Protectorate, Virgin Islands, West Indies, Zanzibar. (Tropicopolitan.)

Remarks: This scale is very destructive to bananas and coconut palms in various parts of the world and is very frequently intercepted at our ports from the West Indies.

6. *Aspidiotus forbesi* Johnson (Cherry Scale)

Scale of female: Approximately circular, somewhat convex and delicate in appearance and about 2 mm. in diameter. Color usually dirty gray. Exuviae subcentral and orange colored.

Scale of male: Rather elongate oval, somewhat darker than the female and about 1 mm. in diameter. Exuvia subcentral and orange colored.

Plants found infested in Florida: Almond (wild), apple, cherry, pecan and plum.

Additional plants found infested elsewhere: *Acer pseudoplatanus*, apricot, beech, *Crataegus* sp., currant, gooseberry, hawthorn, honey locust, jasmine, peach, pear, quince and walnut.

Distribution in Florida: Carbur, Glen Saint Mary, Macclenny, Milford, Monticello and Tampa.

Distribution elsewhere: Alabama, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, Mississippi, New Jersey, New Mexico, New York, North Carolina, Ohio, Virginia, South Carolina, West Virginia; Canada, Germany, Mexico, Nova Scotia, Porto Rico, South Africa.

Remarks: Not a serious pest.

7. *Aspidiotus hederae* (Vall.) (Ivy or Oleander Scale) (Fig. 22)

Scale of female: Circular or very irregular in shape and from 1-2 mm. in diameter. It varies from being flat to rather convex and from a transparent white in the flat specimens to rather an opaque light brown in the convex. Exuviae central or subcentral, light yellow in the flat specimens to very light yellowish brown in the convex.

Scale of male: Similar to that of the female, including variations, but more elongated and smaller, variable.

Plants found infested in Florida: Avocado, bays, *Camellia japonica*, camphor, chinaberry, *Citrus* sp., cycads, Dutchman's pipe, ferns, hibiscus, holly, ivy (English), Jamaica apple, jasmine, *Jatropha multifida*, magnolia, *Mammea africana*, mango, *Ochrocarpos africanus*, oleander, osmanthus, palms, pigeon plum, pokeweed, rose, silk oak (Australian), sweet olive, sycamore, tea olive and white Chinese whist.

Additional plants found infested elsewhere: *Acacia* spp., *Agave palmeri*, *Aloe umbellata*, arbutus, banana, box, *Carpodetus*

serratus, Ceratonia sp., *Cerceris* sp., clover, crape myrtle, croton, currant. *Daphne gnidium, Erica* sp., grass, *Genista* sp., lemons, maple, *Melia* sp., *Myrsine retusa,* orchids, pandanus, *Quercus ilex,* rhododendron, *Rubia peregrina, Ruscus aculeatus,* vinca. *Vitex littoralis, Vriesia splendens,* etc.

Fig. 22. — *Aspidiotus hederae* (Vall.) (Ivy Scale or Oleander Scale). Enlarged twice. (After Wilson.)

Distribution in Florida: General.

Distribution elsewhere: Alabama, California, Georgia, Illinois, Indiana, Massachusetts, Mississippi, New York, North Carolina, Ohio, Pennsylvania, Texas; Algeria, Australia, Austria, Belgium, Bermuda, Canada, Canary Islands, Chili, Cuba, France, Germany, Hawaiian Islands, Italy, Madagascar, Mexico, Morocco, New South Wales, New Zealand, Portugal, Sicily, South Africa, Spain, Sweden, West Indies. Cosmopolitan.

Remarks: Occurs quite abundantly at times, but apparently not a serious pest.

8. *Aspidiotus juglans-regiae* Comst. (English Walnut Scale)

(Fig. 23)

Scale of female: Circular, flat and from 2.25-3 mm. in diameter. The color is variable, according to the host plant, and ranges from grayish to reddish brown. The exuviae are subcentral and reddish brown in color and usually covered with secretion.

Scale of male: Similar to that of the female, but smaller and narrower.

Plants found infested in Florida: Cherry, Cherry laurel, dogwood, elm, gallberry, gordonia, gum (sweet), haw, holly, peach, pear, plum, rose, sumac and tulip poplar.

Additional plants found infested elsewhere: *Acer saccharum* (sugar maple), apple, apricot, ash (white), currant, hackberry, horse chestnut, linden, locust, oak (chestnut) and walnut.

Distribution in Florida: Bartow, Bellair, Brooksville, Bloomingdale, Bradentown, Chipley, Deleon Springs, Gainesville, Greenville, Glen Saint Mary, Jacksonville, Leesburg, Lutz, Macclenny, Midway, Monticello, Olustee, Oneco, Ozona, Palm Sola, Santos, Tampa and Weirsdale.

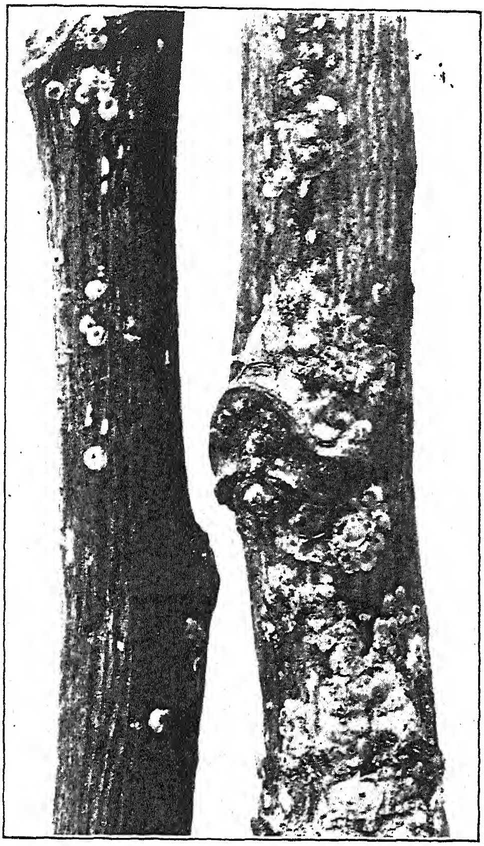


Fig. 23.—*Aspidiotus juglans-regiae* Comst. (English Walnut Scale) Enlarged twice. (After Essig.)

Distribution elsewhere: California, District of Columbia, Indiana, Louisiana, Massachusetts, Mississippi, New Mexico, New York, Ohio, South Carolina, Texas; Canada, Switzerland.

Remarks: Occasionally of economic importance in other states.

9. *Aspidiotus lataniae* Sign. (Latania Scale)

(Fig. 24)

Scale of female: Approximately circular, but irregular when closely crowded, and strongly convex. The diameter is from 1.5-2 mm. Color usually a dirty white. Exuviae rather large, pale brown, central or subcentral, and usually covered with a scant, light colored secretion.

Scale of male: Similar to that of the female, smaller and narrower.

Plants found infested in Florida: *Acacia* sp., *Albizzia* sp., *Althaea* sp., *Aleurites Fordii, Andira* sp., apple, arborvitae, *Artocarpus* sp., *Assonia* sp., Australian pine, avocado, bamboo briar, banana, bay, *Begonia* sp., box, camphor, calodendron, calycanthus, cherry laurel, chinaberry, cinnamon, *Elaeagnus* sp., *Epidendrum* sp., *Euonymus* sp., fern, *Ficus* sp., fig, fruta de pava, gallberry, grape, guava, gum (sweet), holly, honeysuckle, *Ilex cassine,* imperialis, ivy (English), jessamine, juniper, *Lagerstroemia* sp., *Lawsonia* sp., *Ligustrum* sp., loquat, maid of Orleans, mango, matrimony vine, *Melaleuca nesophila, Melastoma*

sp., *Moringa oleifera*, oleander, olive (sweet), palms, pandanus, pear, pecan, persimmon, pink vine, plum, *Plumeria* sp., poinciana, poplar, quince, rose, rose apple, sapodilla, sapota, sea grape, soursop, Spanish lime, spirea, star apple, sycamore, *Tabernaemontana* sp., tea, verbena, walnut, witch hazel and yucca.

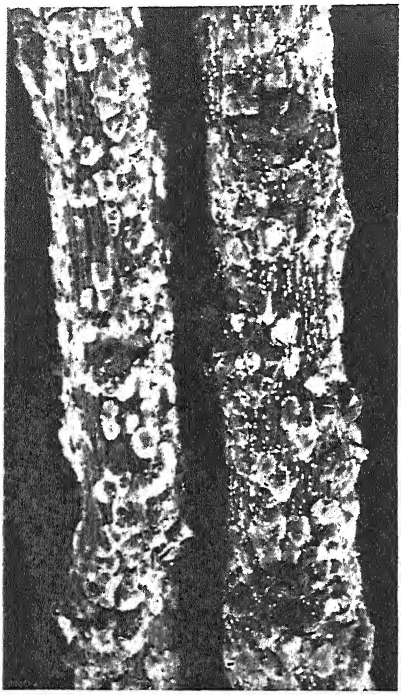


Fig. 24.—*Aspidiotus lataniae* Sign. Latania Scale.) Enlarged twice. (After Wilson.)

Additional plants found infested elsewhere: Almond, aralia, baria, caladium, calabash tree, ceiba, cottonwood, grass, japonica, *Mammea* sp., *Melia azederach*, orange, sand box and *Scalesia* sp.

Distribution in Florida: General.

Distribution elsewhere: Alabama, Arkansas, Georgia, Indiana, Louisiana, Massachusetts, Mississippi, New York, Ohio, South Carolina, Texas; Australia, Bahama Islands, Brazil, Canal Zone, Cuba, England, Europe, Galapagos Islands, Guatemala, Lower California, Mauritius, Mexico, Philippine Islands, Seychelles, South Africa, Uganda Protectorate, Virgin Islands, West Africa, West Indies, Zanzibar. Cosmopolitan.

Remarks: Occurs quite abundantly on palms and Australian pines and its economic importance is still questionable.

10. *Aspidiotus orientalis cocotiphagus* Marlatt (Fig. 25)

Scale of female: Circular or oval according to location on its host; rather flat, and from 1.5-2.6 mm. in diameter. Color, light yellowish brown with edges somewhat lighter. Exuviae central or a little to one side, polished, and a little more transparent and darker than the remainder of the scale; broadly top-shaped. First exuvia about one-half the diameter of the second exuvia, while the second exuvia is somewhat less than a third of the diameter of the whole scale.

Scale of male: Similar to that of the female, smaller and slightly rectilinear.

Plants found infested in Florida: *Anona glabra, Asparagus sprengeri,* avocado, banana, canna, *Cassimora* sp., *Carissa carandas,* carnation, castor bean, *Catha edulis,* Chinaberry, *Cycas* sp., *Ficus* sp., *Hibiscus* sp., *Inodes neglecta, Loroma amethystoria, Maktum asfar,* mango, Natal plum, oleander, Phoory dry date, *Plumeria* sp., palms (coconut, date, fan-leaf, Kentia, latania, royal), rose, rubber, *Tabernaemontana* sp., and trumpet plant.

Additional plants found infested elsewhere: *Citrus trifoliata,* eucalyptus, *Murraya exotica,* osbeckia and sugar apple.

Distribution in Florida: Arch Creek, Buena Vista, Cape Sable, Coconut Grove, Florida Keys, Fort Myers, Key West, Little River and Miami.

Distribution elsewhere: Bahama Islands, British West Indies, Ceylon, Cuba, India, Mexico.

Remarks: Of economic importance on coconut palms, doing considerable damage to the foliage. This varietal difference was originally described as a distinct species by Marlatt but Mr. E. E. Green writes: "I should be inclined to regard it as a well marked variety of *orientalis*".

Fig. 25.—*Aspidiotus orientalis* Newst. Enlarged.

11. *Aspidiotus osborni* Newell & Ckll.

Scale of female: Rather irregular in shape, from circular to oval, flat and from 1.5-2 mm. in diameter. The color is similar to that of the bark or a dirty gray. Exuviae subcentral, covered with secretion, but orange-colored when secretion is rubbed off.

Scale of male: Similar to that of the female, smaller and elongated.

Plants found infested in Florida: Blueberry, grape, oak, pecan, persimmon (wild), plum and walnut.

Additional plants found infested elsewhere: *Acer* sp., apple, cherry, chestnut, currant, *Ostrya virginica* and *Quercus alba*.

Distribution in Florida: Archer, Campville, Cottage Hill, Daytona, Fort Pierce, Glen Saint Mary, Jacksonville, Macclenny, Mims, Monticello, Oldsmar, Pensacola, Sutherland and Tallahassee.

Distribution elsewhere: California, Georgia, Iowa, Kansas, Lower California.

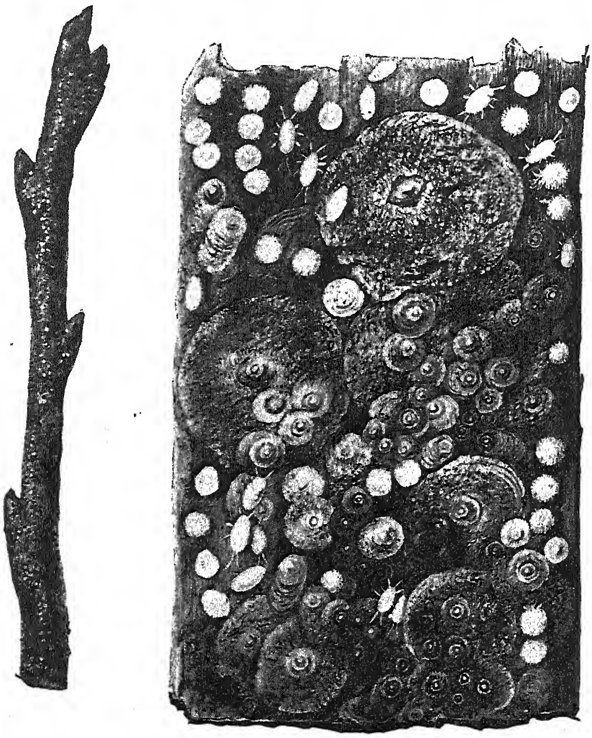
Remarks: Apparently not a serious pest in Florida.

12. *Aspidiotus perniciosus* Comst. (San Jose Scale)
(Fig. 26)

Scale of female: Circular, slightly convex and from 1-2 mm. in diameter. Color, varying from smoky black to gray. Exuviae central or subcentral and when not covered with secretion are pale or reddish yellow.

Scale of male: Rather oblong-oval and about twice as long as broad. Color, darker than that of the female. Exuvia sublateral or away from the center.

Plants found infested in Florida: *Akebia quinata*, apple cherry, cherry laurel, *Citrus trifoliata*, *Elaeagnus* sp., elm, fig, grape, *Hypericum* sp., japonica, lilac,



a b

Fig. 26.—*Aspidiotus perniciosus* Comst. (San Jose Scale.) On bark: a, infested twig, natural size; b, on bark as it appears greatly magnified. (From Bul. No. 3, U. S. D. A., Bureau of Entomology, figure 2, p. 36.) (After Howard and Marlatt.)

peach, pear, pecan, persimmon, plum, poplar, privet, quince, red osier, rose, *Sieboldiana* sp., spirea and walnut.

Additional plants found infested elsewhere: *Acacia* sp., *Acer* sp., alder, almond, apricot, arborvitae, ash, birch, buckthorn, button bush, catalpa, catawba, *Ceanthus* sp., cedar, *Cercidiphyllum japonicum*, chestnut, chokecherry, cotoneaster, *Crataegus* sp., dogwood, elder, eucalyptus, gooseberry, hawthorn, *Hibiscus* sp., honeysuckle, hop-tree, horsechestnut, huckleberry, laurel, linden, locust (honey), loquat, milkweed, mulberry, *Nyssa* sp., smoke bush, snowball, spruce, strawberry, sumac, Virginia creeper, willow, etc.

Distribution in Florida: General.

Distribution elsewhere: United States, Algeria, Argentina, Australia, Brazil, Canada, Chili, China, England, France, Formosa, Germany, Hawaiian Islands, Japan, Mexico, New Zealand, South Africa, Victoria.

Remarks: This scale is a serious pest wherever it occurs on peach, plum, apple, pear, rose and some other plants.

13. *Aspidiotus pini* Comst.
(Fig. 27)

Scale of female: Rather elongated with the sides nearly parallel and the ends rounded. Length 2-3 mm.; width 1 mm. Color dark gray, with a brownish or purplish tinge; margin lighter colored. Exuviae central, covered with secretion.

Scale of male: Much smaller than the female and about the same color.

Plants found infested in Florida: *Pinus palustris*.

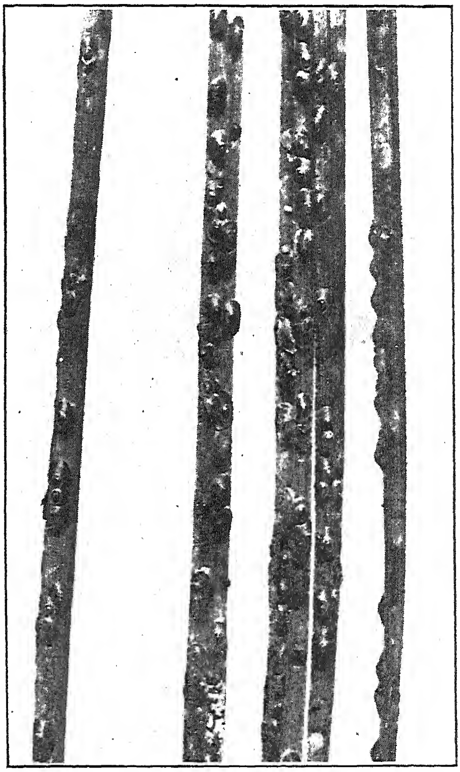


Fig. 27.—*Aspidiotus pini* Comst. (Synonym *A. Californicus* Coleman.) Enlarged twice. (After Essig)

Additional plants found infested elsewhere: Pines and *Pseudotsuga taxifolia*.

Distribution in Florida: Coconut Grove, Silver Palm and West Palm Beach.

Distribution elsewhere: California, Europe.

Remarks: Not of economic importance in Florida. The distribution of this scale is apparently questionable owing to confusion with *A. abietis* (Schr.).

14. *Aspidiotus pseudospinosus* Woglum

Scale of female: Generally circular, sometimes ovate, and slightly convex. It varies from 1.5-2 mm. in diameter. It is covered with a brown fungus.

Scale of male: Unknown.

Plants found infested in Florida: *Andromeda* sp., live oak and saw palmetto.

Distribution in Florida: Fort Pierce, Lake Butler, Lake City, and West Palm Beach.

Distribution elsewhere: Not known.

Remarks: Little is known about this scale. Originally described from Florida specimens.

15. *Aspidiotus rapax* Comst.
(Greedy Scale)

(Fig. 28)

Scale of female: Approximately circular, convex and from 1-1.5 mm. in diameter. Color, usually gray, sometimes more or less whitish. Occasionally the scale is slightly transparent. Exuviae subcentral and indicated by a brown or black nipple.

Fig. 28.—*Aspidiotus rapax* Comst. (Greedy Scale) Enlarged. (After Douglas)

Scale of male: Similar to the female scale, less convex and smaller. Exuvia subcentral.

Plants found infested in Florida: Australian silk oak, avocado, bay, cactus, camphor, Chinaberry, *Euonymus* sp., *Elaeagnus* sp., fig, geranium, guava, holly, honeysuckle, juniper, loquat, magnolia, morning-glory, myrtle, mulberry, oak, palms, pear, pecan, persimmon (wild), *Plumeria* sp., privet, rose, sapodilla and *Tecoma* sp.

Additional plants found infested elsewhere: *Acacia* sp., almond, apple, birch, buck bush, *Camellia* sp., *Cercis* sp., cherry, *Cissus* sp., *Coprosma* sp., cottonwood, English ivy, *Eucalyptus* sp., *Fuchsia* sp., *Genista* sp., grape, grapefruit, heath, honey locust, laurel, *Lavatera* sp., lemon, maple, mistletoe, *Myoporum* sp., nightshade, olive, pomegranate, quince, redbud, *Rhamnus crocea,* sage, *Sedum* sp., silver tree, *Strelitzia* sp., tea, walnut, willow and others.

Distribution in Florida: General.

Distribution elsewhere: United States, Australia, Brazil, Cuba, Europe, Hawaiian Islands, India, Lower California, Mexico, Natal, New Zealand, Portugal, Rhodesia, South Africa, Spain, West Indies.

Remarks: Occasionally a serious pest.

16. *Aspidiotus spinosus* Comst.

Scale of female: Circular, slightly convex and varying from 1-1.5 mm. in diameter. Color varying from light brown to a rather dirty white. Exuviae central and covered with secretion.

Scale of male: Similar to female, smaller and more elongated. Exuvia sublateral.

Plants found infested in Florida: Australian pine, *Camellia* sp., camphor, fig, haw (red), palms, raspberry, rose and zamia.

Additional plants found infested elsewhere: *Arenga saccharifera,* asparagus fern and grape.

Distribution in Florida: Buena Vista, Jacksonville, Kissimmee, Key Biscayne, Lake City, Oneco, St. Augustine, South Jacksonville, Tampa and Wiersdale.

Distribution elsewhere: Eastern United States, New York; Cuba, England, Lower California, Nassau (Bahama Islands).

Remarks: This insect does not occur very abundantly in Florida.

17. *Aspidiotus subsimilis anonae* Houser
(Fig. 29)

"Scale of Female: 1 to 1.9 mm. in diameter; irregularly circular; thin, tough; slightly convex; very inconspicuous, due in part to the fact that the insect is partly mining in its habit as particles of thin bark usually extend over the scale; dorsal shed skin conspicuous; located on bark of host; no dot or ring present."

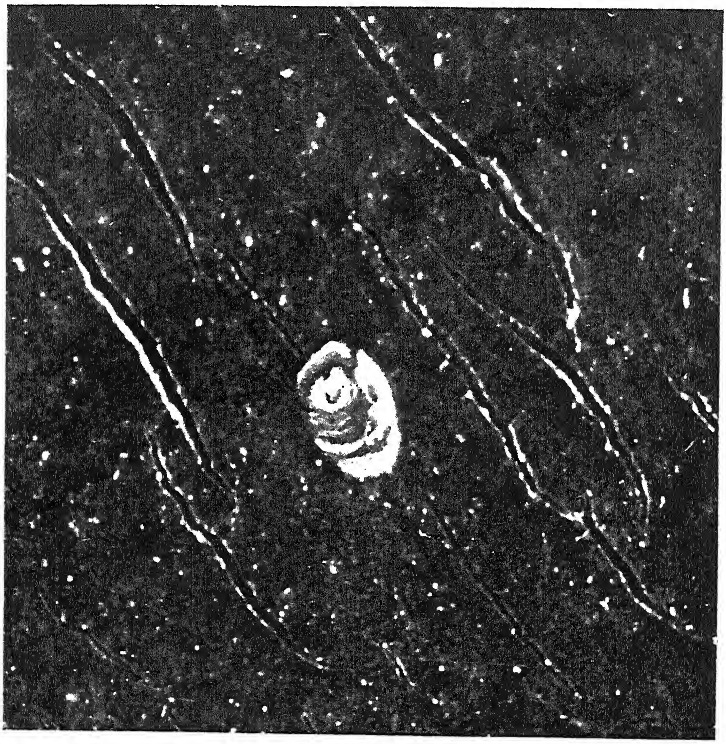


Fig. 29.—*Aspidiotus subsimilis anonae* Houser. Greatly enlarged.

Scale of male: Not known.

Plants found infested in Florida: *Mangifera acambodiana*, loquat, hog plum *(Spondias purpurea)* and poisonwood *(Metopium toxiferum)*.

Additional plants found infested elsewhere: Bobug tree, ceiba, *Delonix regia*, *Eugenia* sp., Jamaica apple, palm, poinciana, sapodilla, soursop and sugar apple.

Distribution in Florida: Key West and Miami.

Distribution elsewhere: Bahama Islands, Cuba, Isle of Pines, Lower California, Mexico, Peru, Spanish Honduras.

Remarks: The economic importance of this scale is unknown. The above description by Professor J. S. Houser is taken from the "Annals Entomological Society of America," Vol. XI, No. 2, June, 1918, page 163.

18. *Aspidiotus uvae* Comst. (Grape Scale)
(Fig. 30)

Scale of female: Circular, flattened and from 1.1-2 mm. in diameter. Color varying from yellowish to light brown. Exuviae light yellow and subcentrally located.

Scale of male: Smaller, narrower and more convex than the female scale. Slightly darker. Exuvia sublateral (nearer one end.)

Plants found infested in Florida: Grape.

Additional plants found infested elsewhere: Hickory, peach and sycamore.

Distribution in Florida: Macclenny.

Distribution elsewhere: Georgia, Illinois, Indiana, Kansas, Mississippi, Ohio, Tennessee, Texas; Europe, France, Jamaica.

19. *Aulacaspis rosae* (Bouche)
(Rose Scale)
(Fig. 31)

Scale of female: Circular, but oval or very irregular when crowded. The diameter varies from 2-3 mm. Color white or dirty white. The scale is very thin and semi-opaque. Exuviae marginal or submarginal (at or near the margin); usually of a dull yellowish brown color.

Scale of male: Somewhat rectilinear and from 1-1.5 mm. in length. Color whitish. It is tricarinated (see figure

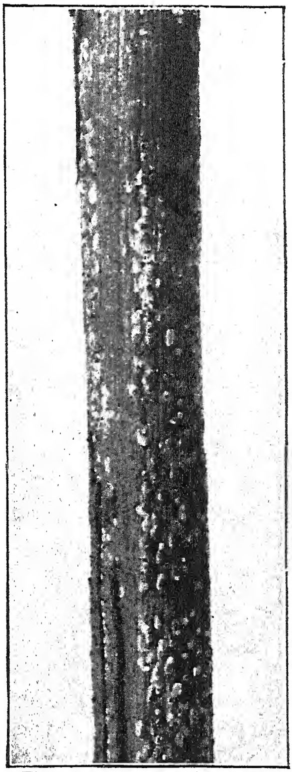


Fig. 30. — *Aspidiotus uvae* Comst. (Grape Scale) Natural size. (After Douglas)

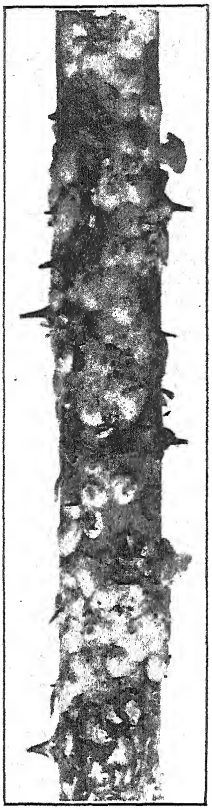


Fig. 31.—*Aulacaspis rosae* (Bouche) (Rose Scale) Slightly enlarged. (After Essig)

17 B). Exuvia terminal (at front end), brown and about one-fourth the length of the female scale.

Plants found infested in Florida: Blackberry and rose.

Additional plants found infested elsewhere: *Ailanthus* sp., *Cycas* sp., dewberry, Himalaya berry, mango, myrtle, pear, raspberry, *Rubus* spp., strawberry, etc.

Distribution in Florida: Gainesville, Jacksonville, Kingston, Madison, Pensacola, Quincy, Sanford and South Jacksonville.

Distribution elsewhere: Alabama, California, Connecticut, District of Columbia, Georgia, Illinois, Indiana, Kentucky, Maine, Michigan, Mississippi, New Jersey, New York, North Carolina, Ohio, Rhode Island, South Carolina, Texas, West Virginia; Australia, Barbados, British Columbia, British Guiana, Canada, Chili, China, Demerara, England, Europe, Fiji, France, Hawaiian Islands, Italy, Japan, Mexico, New Zealand, Philippine Islands, Portugal, South Africa, Sweden, Switzerland, West Indies. Probably cosmopolitan.

Remarks: Occasionally a serious pest but easily controlled if proper control measures are promptly applied (oil sprays or soap solutions).

20. *Chionaspis americana* Johnson (Elm-tree White Scale) (Fig. 32)

Scale of female: Very nearly pear-shaped, widest behind the middle. From 2-3.5 mm. long. Color pure white, but the scale is invariably dirty in appearance, being covered with particles of bark or dust owing to its being washed by the rains or heavy dews. Exuviae located at the front end and reaching about one-half the length of the scale; brown in color, when not covered by particles or secretion.

Scale of male: Long, slender, sides not necessarily parallel. About 1 mm. long. Color white. Distinctly tricarinate. Exuvia

about two-fifths the length of the scale, terminal, light yellow in color.

Plants found infested in Florida: Elm.

Additional plants found infested elsewhere: *Ulmus* spp., and red haw *(Crataegus coccinea)*.

Distribution in Florida: Palatka.

Distribution elsewhere: Connecticut, Illinois, Indiana, Iowa, Kansas, Massachusetts, Minnesota, Mississippi, Missouri, New York, Ohio, Oklahoma, Texas.

Remarks: Only a very slight infestation reported in Florida.

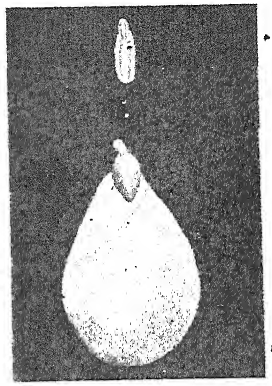


Fig. 32.—*Chionaspis americana* Johnson. (Elm-tree White Scale) Greatly enlarged. (After Cooley)

21. *Chionaspis caryae* Cooley

(Fig. 33)

Scale of female: Normally pear-shaped in single specimens, but when crowded very irregular; moderately convex. Length 1.7-2 mm. Color white or dirty white. The exuviae are terminal (at front end) and take up about one-fifth the length of the scale; pale yellow or brown in color.

Scale of male: Oblong or elliptical in outline. About 1 mm. in length, having a distinct median carina. Color dirty white. Exuvia brownish and about one-third the length of the scale.

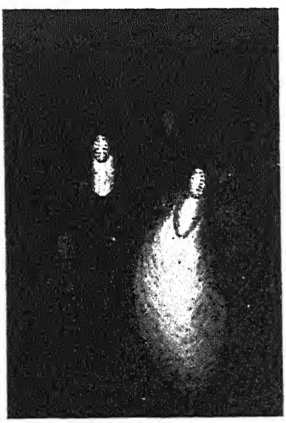


Fig. 33. — *Chionaspis caryae* Cooley. Greatly enlarged. (After Cooley)

Plants found infested in Florida: Pecan.

Additional plants found infested elsewhere: Black walnut *(Juglans nigra)* and hickory.

Distribution in Florida: Summerfield.

Distribution elsewhere: District of Columbia, Indiana, and Ohio.

Remarks: Not a serious pest in Florida.

22. *Chionaspis citri* Comst. (Citrus Snow Scale) (Fig. 34)

Scale of female: Somewhat oyster-shell-shaped, moderately convex and from 1.5-2.25 mm. long. Color varying from brown to a dirty blackish brown with the margin the same or of a lighter color. Some specimens have a central, longitudinal ridge from which the sides slope to the margin. Exuviae brownish yellow and about one-third the length of the scale.

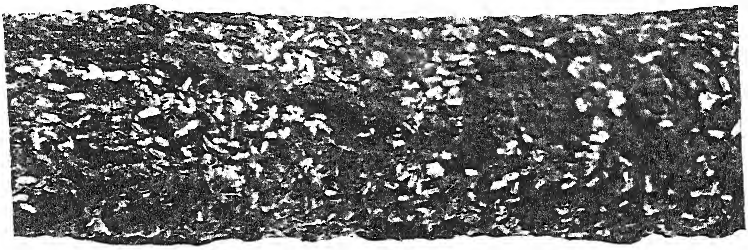


Fig. 34.—*Chionaspis citri* Comst. (Citrus Snow Scale) Enlarged twice. (After Wilson)

Scale of male: Slender, with the side margins parallel; white; distinctly tricarinate (three ridged). Exuvia yellowish or yellowish brown.

Plants found infested in Florida: Citrus.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: City Point, Geneva, Lotus, St. Cloud, Seffner and Tampa.

Distribution elsewhere: Southern States, California; Africa, Antigua, Argentina, Australia, Bermuda, Brazil, British Guiana, Cuba, Fiji, Japan, Mauritius, Mexico, New Zealand, Panama Canal Zone, St. Lucia (Windward Islands), Samoa, Uruguay, West Indies.

Remarks: While known to be abundant locally, yet probably never a dangerous pest.

23. *Chionaspis euonymi* Comst. (Euonymus Scale) (Fig. 35)

Scale of female: Narrow at the exuvial end, widening rapidly at about the first fourth of its length, thereby making, at times, the hinder portions wider than the length. Length 1.5-2.2 mm. Color dark grayish or blackish brown, with the margins lighter. Exuviae terminal (at the front end) and copper-colored.

Scale of male: Elongate, narrow, sides parallel. Length about 1 mm. Color, white. It is distinctly tricarinate (three ridged).

Plants found infested in Florida: *Euonymus japonicus.*

Additional plants found infested elsewhere: *Euonymus* spp.

Distribution in Florida: Oneco, Pensacola and Tallahassee.

Distribution elsewhere: California, Georgia, Mississippi, New York, Ohio, Texas, Virginia; Austria, England, France, Italy, Transcaucasia.

Remarks: This scale becomes a very serious pest at times.

24. *Chionaspis pinifoliae* (Fitch)
(Pine-leaf Scale)
(Fig. 36)

Scale of female: Usually parallel sided owing to the narrowness of the pine leaves. Length 3-4 mm. Color, a glossy snow-white. Exuviae light yellow.

Scale of male: Slightly broadened toward the posterior (hinder) end, smooth and about 1 mm. long. Color white. It is distinctly

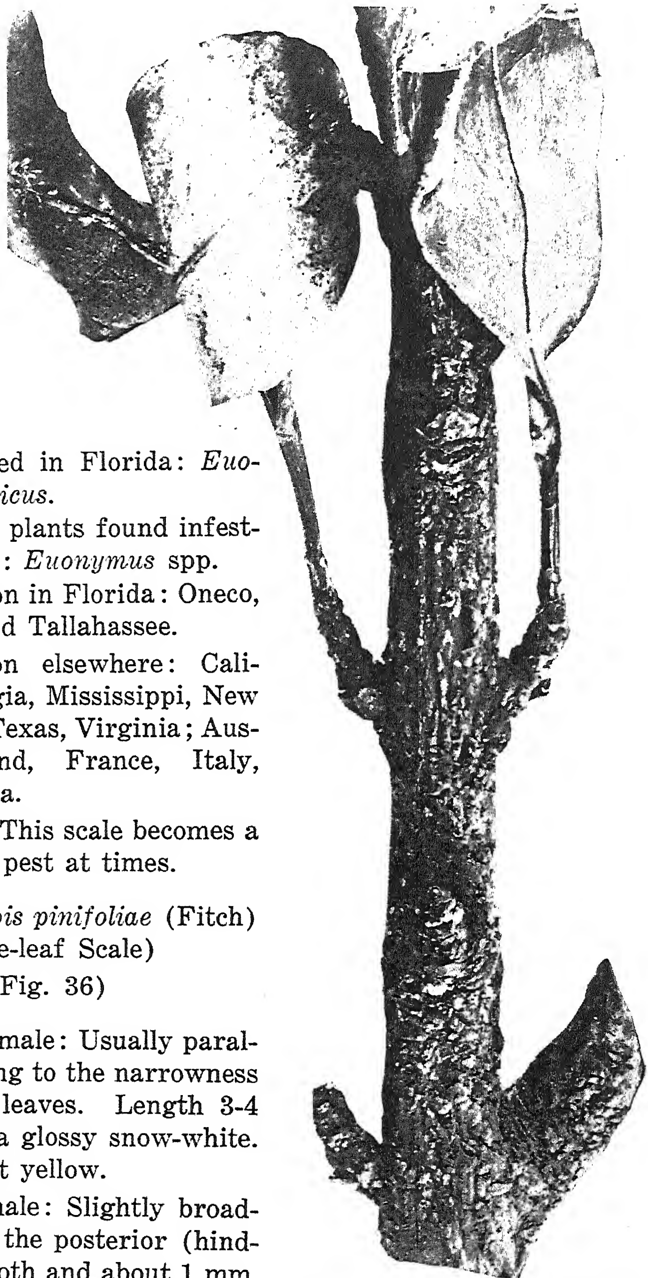


Fig. 35.—*Chionaspis euonymi* Comst. (Euonymus Scale) Enlarged twice. (After Wilson)

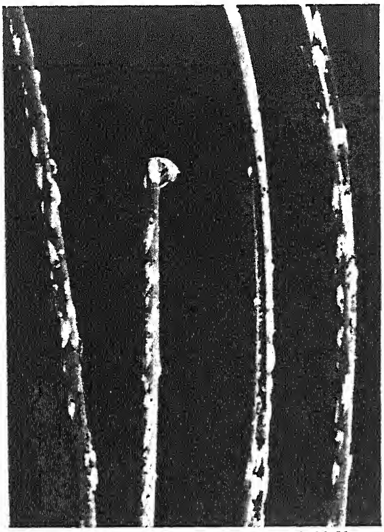


Fig. 36. — *Chionaspis pinifoliae* (Fitch) (Pine-leaf Scale) Enlarged twice. (After Wilson)

tricarinated. Exuvia terminal; yellow or colorless; covering about one-third the length of the scale.

Plants found infested in Florida: Juniper and pine.

Additional plants found infested elsewhere: Coniferous trees.

Distribution in Florida: Bradentown, Fort George, Gainesville, Palmetto and Sarasota.

Distribution elsewhere: United States; Canada, Lower California, Spain.

Remarks: Not of economic importance.

25. *Chionaspis pinifoliae heterophyllae* Cooley (Pine Scale)

This species is not separable from *Chionaspis pinifoliae* except by the lobes of the female insect.

Plants found infested in Florida: Pines.

Additional plants found infested elsewhere: Coniferous trees.

Distribution in Florida: Uncertain.

Distribution elsewhere: Mississippi, Rhode Island.

Remarks: Not of economic importance. Owing to the likelihood of this scale being confused with *Chionaspis pinifoliae* (Fitch), locality records cannot safely be given at this time.

26. *Chionaspis quercus* Comst. (Oak Chionaspis)
(Fig. 37)

Scale of female: Rather long, narrow at the exuvial end and widened toward the posterior (hinder) end; convex. Length about 2 mm. Color varying from light to dark gray. The exuviae are terminal (at the front end) and yellowish brown in color.

Scale of male: Narrow. Distinctly tricarinated (three ridged). About 1 mm. long. White. Exuvia terminal, yellow.

Plants found infested in Florida: Live oak and water oak.

Additional plants found infested elsewhere: Maul oak and white oak.

Distribution in Florida: Fort Pierce and West Palm Beach.

Distribution elsewhere: California, New Mexico; Lower California, Mauritius.

Remarks: Not of economic importance.

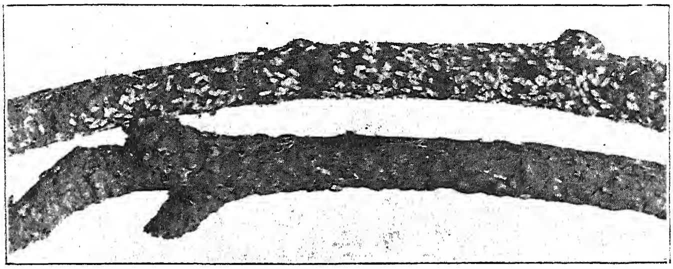


Fig. 37.—*Chionaspis quercus* Comst. (Oak Chionaspis) Enlarged twice. (After Essig)

27. *Chionaspis salicis-nigrae* (Walsh) (Willow Scale) (Fig. 38)

Scale of female: Shape somewhat elliptical; moderately long; quite convex; widest near middle. Length varying from 2.6-4 mm. Color, white or dirty white. Exuviae terminal; yellow or brownish yellow.

Scale of male: Shape somewhat oval; parallel-sided or broadened toward the hinder end. Length about 1 mm. Color white. Feebly tricarinated. Exuvia yellow or brown and length equal to about one-third that of the male scale.

Plants found infested in Florida: Willow.

Additional plants found infested elsewhere: *Ceanothus* sp., deerbrush, maple (big leaf), poplar, red-osier dogwood *(Cornus stolonifera)*, shad-bush *(Amelanchier canadensis)*, tulip tree and others.

Distribution in Florida: Leesburg.

Distribution elsewhere: Arizona, California, Colorado, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, New Mexico, New York, Ohio, South Dakota, Texas, Washington; Canada.

Remarks: Not of economic importance in Florida.

28. *Chionaspis sylvatica* Sanders

Scale of female: Shape very irregular, sometimes elongated and rounded posteriorly, and sometimes decidedly broadened and

truncated posteriorly, giving the scale a triangular shape. Length 1.5-2 mm. Color dirty white to light buff. Exuviae terminal; brownish in color.

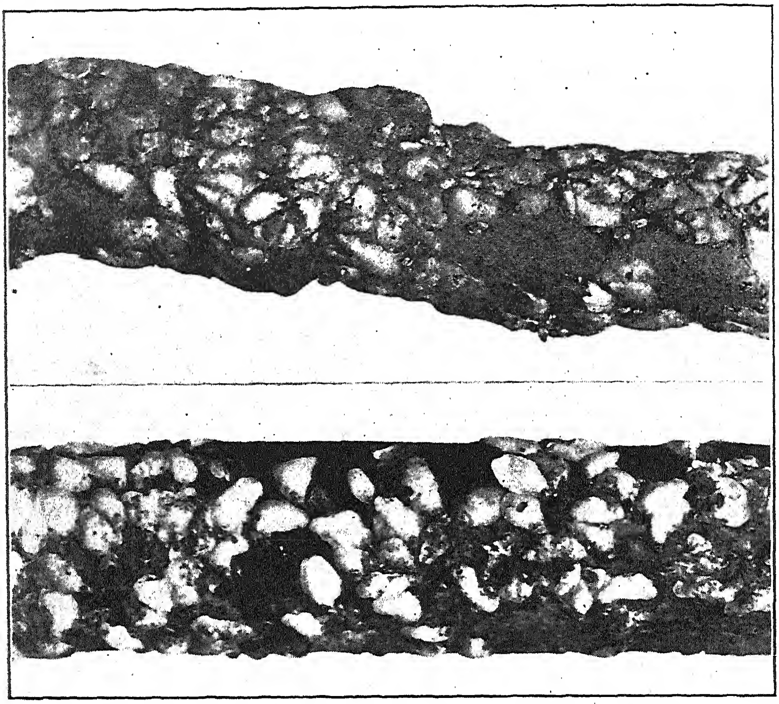


Fig. 38.—*Chionaspis salicis-nigrae* (Walsh.) (Willow Scale) Enlarged three times. (After Essig)

Scale of male: Shape somewhat oval; parallel sided. Length .6-1 mm. Color white. Strongly tricarinated. Exuvia small, semitransparent, delicate and covering about one-fifth the length of the scale.

Plants found infested in Florida: Tupelo gum *(Nyssa sylvatica)*.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Gainesville.

Distribution elsewhere: District of Columbia, Maryland, Ohio, Pennsylvania, Virginia, West Virginia.

Remarks: Not of economic importance in Florida.

29. *Chrysomphalus aonidum* (Linn.) (Florida Red Scale) (Fig. 39)

Scale of female: Circular, moderately convex and about 2 mm. in diameter. Color varying from a dark reddish brown to almost black; margin somewhat ashy gray. Exuviae approximately central, reddish brown or brick-red in color; sometimes covered with a grayish secretion and surrounded by a reddish brown ring.

Scale of male: More or less oval; about one-half as long as the female and a little lighter colored. Exuvia sublateral.

Plants found infested in Florida: Agave, apple, *Aralia* sp., asparagus fern, Australian silk oak, avocado, banana, bay, bottle brush, boxwood, brushwood, caladium, *Camellia japonica*, camphor, canna, *Carissa bispinosa, Cedrela odorata*, century plant, *Chamaedorea* sp., cherry laurel, cinnamon, *Citrus* spp., crape myrtle, *Cycas* sp., *Dypsis madagascariensis, Elaeagnus* sp., *Eucalyptus* sp., *Eugenia* sp., *Euonymus japonicus, Ficus* spp., guava, holly, ivy (English), ivy (German), jasmine, *Jasminum humila*, laurel, *Ligustrum* sp., magnolia, mammee apple, mango, mountain ebony, mulberry, oleander, orchid, *Osmanthus fragrans*, palms, pecan, *Phoenicophorium sechellarum*, poinsettia,

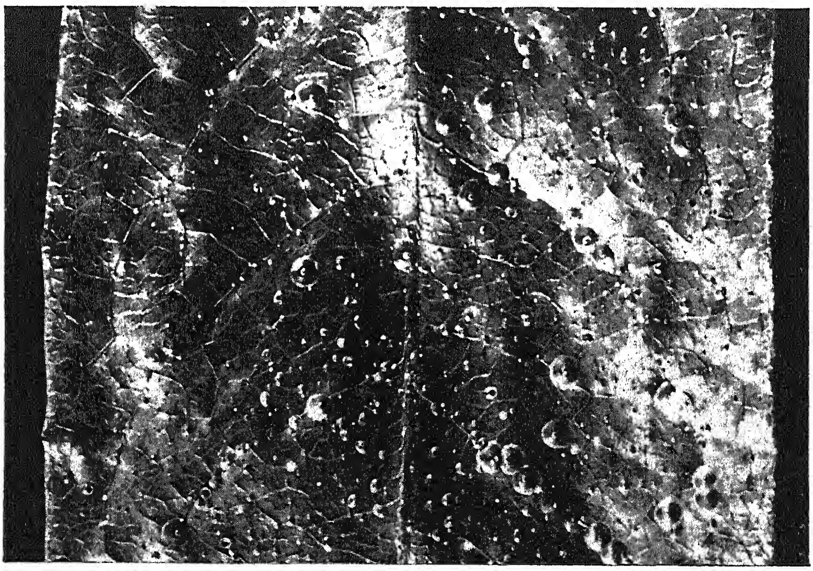


Fig. 39.—*Chrysomphalus aonidum* (Linn.) (Florida Red Scale) Enlarged twice. (Photo by E. W. Berger)

privet, *Rhynchospermum* sp., *Roscheria melanochaetes*, rose, rubber, screw pine (*Pandanus* sp.), sea grape, soursop, sugar apple,

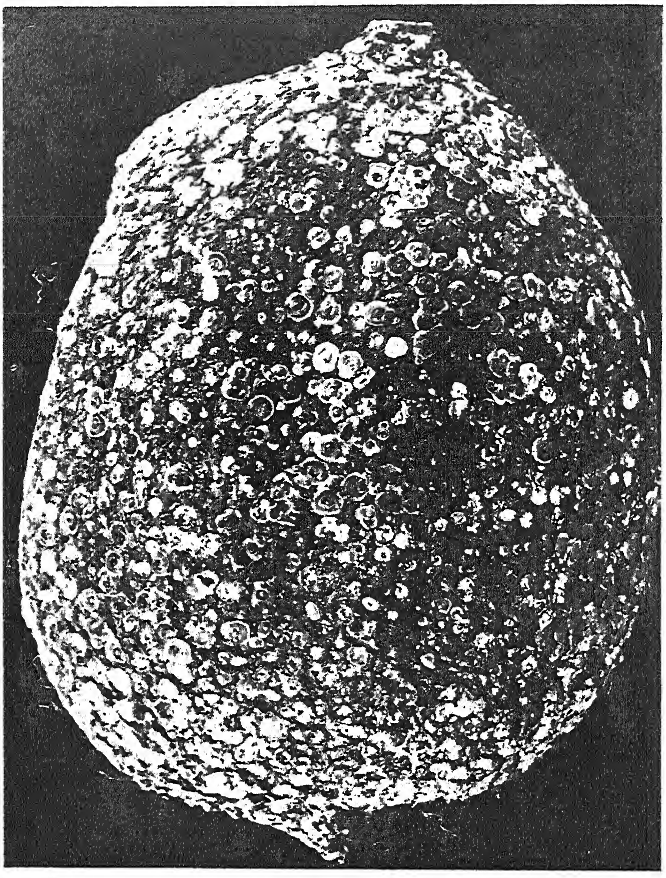


Fig. 40.—*Chrysomphalus aurantii* (Mask.) (California Red Scale) Enlarged twice. (After Wilson)

sweet olive, Surinam cherry, *Tabernaemontana* sp., tea olive, traveller's tree and *Zamia* sp.

Additional plants found infested elsewhere: *Araucaria bidwelli, Aspidistra lurida,* begonia, rhododendron, etc.

Distribution in Florida: General.

Distribution elsewhere: California, Colorado, Connecticut, District of Columbia, Georgia, Illinois, Indiana, Louisiana, Mississippi, New Mexico, New York, Ohio, Texas, Wisconsin; Algeria, Argentina, Australia, Barbados, Brazil, Ceylon, Chili, China, Cuba, Egypt, England, Europe, Hawaii, India, Jamaica, Japan,

Lower California, Mauritius, Mexico, Natal, Panama Canal Zone, Philippine Islands, Seychelles. Tropicopolitan.

Remarks: This scale is of considerable economic importance on citrus, palms, camphor and roses.

30. *Chrysomphalus aurantii* (Mask.) (California Red Scale) (Fig. 40)

Scale of female: Circular, flat and averaging 2 mm. in diameter. Color (with insect removed) gray with a faint yellowish tinge. With the insect under the scale, it is reddish brown or copper-colored. The scale is somewhat transparent allowing the kidney-shaped insect to show through. Exuviae approximately central.

Scale of male: Similar to that of the female but smaller and somewhat elongated. Exuvia sublateral.

Plants found infested in Florida: Bamboo briar, *Carissa* sp., *Citrus* spp., oleander, palm and sweet bay *(Laurus nobilis)*.

Additional plants found infested elsewhere: *Acacia* sp., aloe, apple, bread-fruit *(Artocarpus* sp.), box-elder, boxwood, citron, *Kennedya* sp., lignum-vitae, burmarigold, nightshade, palms, passion vine, pear, pistacio, *Podocarpus* sp., privet, quince, rose, sago "palm" *(Cycas* sp.), tea, walnut (English) and willow.

Distribution in Florida: City Point, Clearwater, Cocoa, Coconut Grove, Goulds, Homestead, Indianola, Indian Rocks, Larkins, Miami, Oakhurst, Ozona, Pine Castle, Princeton, Redland, St. Petersburg, Seminole, Sharpes, Silver Palm, Sutherland and White City.

Distribution elsewhere: California, Indiana, New York, Ohio; Antigua, Australia, Brazil, British East Africa, Cape Colony, Caucasia, Ceylon, China, Crete, Cyprus, Fiji, Greece, Hawaiian Islands, Indo-China, Italy, Japan, Lower California, Malta, Mauritius, Mexico, Morocco, Natal, New Caledonia, New Zealand, Philippine Islands, Porto Rico, Portugal, Samoa, South Africa, Southern Europe, Syria, West Indies. Tropicopolitan.

Remarks: This scale is becoming of economic importance, especially on the lower east coast of Florida.

31. *Chrysomphalus aurantii citrinus* (Coq.) (Yellow Scale) (Fig. 41)

Scale of female: Circular, flat, margin irregular and from 1.5-3 mm. in diameter. Color yellow. Exuviae approximately central.

Scale of male: Unknown.
Plants found infested in Florida: Citrus.
Aditional plants found infested elsewhere: *Aucuba* sp., *Daphne*

Fig. 41.—*Chrysomphalus aurantii citrinus* (Coq.) (Yellow Scale) Enlarged twice. (After Wilson)

sp., *Euonymus* sp., *Ficus indica* (India rubber), ginger (wild Japanese) and ivy (English).

Distribution in Florida: Cocoa.

Distribution elsewhere: California, Japan.

Remarks: This variety is reported as feeding only on leaves and fruit. Structurally there appears to be little, if any, difference between *Chrysomphalus aurantii citrinus* (Coq.) and *Chrysomphalus aurantii* (Mask.). The only means of differentiation available to the observer are in the color and the feeding habits.

32. *Chrysomphalus dictyospermi* (Morgan) (Dictyospermum Scale)
(Fig. 42)

Scale of female: Circular, slightly convex, rather thin and varying from 1.5-2 mm. in diameter. Color grayish, light brown or of a coppery tinge. Exuviae approximately central, ringed and nipple-like.

Scale of male: Similar but smaller and more elongated than the female. Exuvia sublaterally located.

Plants found infested in Florida: *Acacia* sp., *Agave* sp., *Albizzia* sp., *Allamanda* sp., Apollo laurel, arbor-vitae, asparagus fern, avocado, Australian pine, *Bahia fastigata,* banana, Barbados cherry, bay, bottle brush, boxwood, caladium, *Camellia* sp., camphor, canna, *Carissa* sp., century plant, cinnamon, *Citrus* spp., creeping fig, *Cycas* sp., English ivy, *Elaeagnus* sp., *Eucalyptus* sp., *Eugenia* sp., fern, *Ficus* sp., guava, jasmine, *Ligustrum* sp., loquat, magnolia, mango, *Mammea* sp., mountain ebony, mulberry, oleander, orchid, palms, Panama hat plant, *Pandanus* sp., pecan, poinsettia, privet, *Rheedia aristata,* rose, rose apple, syzygium, tea plant, traveler's tree, willow and *Zamia* sp.

Additional plants found infested elsewhere: Billbergia, *Bachis mayor, Anthurium* sp. and croton.

Distribution in Florida: General.

Distribution elsewhere: United States; Africa, Argentina, Bahama Islands, Barbados, Brazil, British Honduras, Canary Islands, China, Corsica, Cuba, Demerara, Dominica, England, Fiji, France, Guatemala, Honduras, Italy, Jamaica, Java, Madeira, Mexico, Panama Canal Zone, Philippine Islands, Porto Rico, Portugal, Russia, Seychelles, Sicily, South Africa, Spain, Spanish Honduras, Uganda Protectorate, West Indies, Zanzibar. Probably cosmopolitan.

Remarks: In Florida, this scale is a serious pest on avocado and certain ornamental plants.

33. *Chrysomphalus mimosae* (Comst.) (Mimosa Scale)

Scale of female: Circular or elongated, moderately convex and from 1-2 mm. in diameter. Color usually agreeing well with the

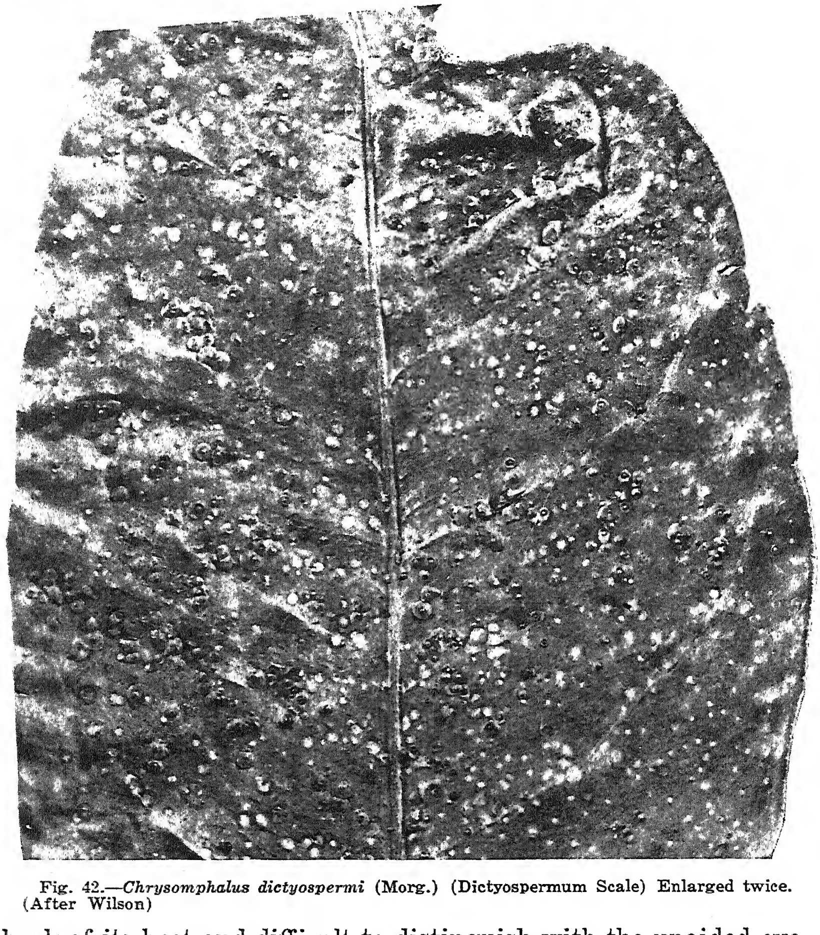


Fig. 42.—*Chrysomphalus dictyospermi* (Morg.) (Dictyospermum Scale) Enlarged twice. (After Wilson)

bark of its host and difficult to distinguish with the unaided eye. Exuviae central and usually surrounded by a concentric ring, whitish gray in color.

Scale of male: Similar to that of the female, but smaller and more oval than circular. Exuvia near the anterior end.

Plants found infested in Florida: "Hog plum" *(Spondias purpurea)*.

Additional plants found infested elsewhere: Mimosa.
Distribution in Florida: Key West.
Distribution elsewhere: Mexico.
Remarks: This is a serious pest on its Florida host plant.

34. *Chrysomphalus obscurus* (Comst.) (Obscure Scale)
(Fig. 43)

Scale of female: Approximately circular, slightly convex and about 3 mm. in diameter. Color very dark gray, at times resembling the color of the bark. Exuviae subcentral, shining black, usually covered by gray secretion which is surrounded by a whitish ring; low-crater-like.

Scale of male: Oval and smaller but otherwise similar to the female. Exuvia sublateral.

Plants found infested in Florida: Chestnut, chinquapin, grape, hog plum *(Spondias purpurea)*, oaks and wild myrtle.

Additional plants found infested elsewhere: Dogwood, hickory, maple and pecan.

Distribution in Florida: General.

Distribution elsewhere: Arkansas, District of Columbia, Illinois, Indiana, Kansas, Louisiana, Mississippi, Ohio, Texas.

Remarks: Occurs abundantly on oaks but is usually controlled by its natural enemies.

Fig. 43.—*Chrysomphalus obscurus* (Comst.) Obscure Scale) Enlarged twice. (After Wilson)

35. *Chrysomphalus perseae* (Comst.) (Red Bay Scale)
(Fig. 44)

Scale of female: Circular, flat and varying from 1.25-2 mm. in diameter. Color dark reddish brown or chocolate-brown. Exuviae central; very dark gray to almost black, having a whitish ring around the central portion.

Scale of male: Oval and smaller than the female. Exuvia black and sublaterally located.

Plants found infested in Florida: Avocado, bay, cabbage palmetto, camphor, *Gordonia* sp., hemlock (?), Jacob's ladder, magnolia, olive, palm, short-leaf pine, *Xolisma fruticosa* and *Zamia pumila*.

Additional plants found infested elsewhere: *Anthurium* sp., *Harrissii* sp., *Ilex* sp. and *Viburnum* sp.

Fig. 44.—*Chrysomphalus perseae* (Comst.) (Red Bay Scale) Enlarged twice. (After Wilson)

Distribution in Florida: Bartow, Brooksville, Chattahoochee, Daytona, Fort Pierce, Gainesville, Glen Saint Mary, Jacksonville, Lake Lucerne, Lake Wales, Lawtey, Miami, New Smyrna, Palm Beach, Sanibel, Sutherland, West Palm Beach and Winter Haven.

Distribution elsewhere: Mississippi, New Jersey; Brazil, Central America, Cuba, England, Guatemala, Mexico, Venezuela.

Remarks: This scale does not occur very abundantly in Florida.

36. *Chrysomphalus tenebricosus* (Comst.) (Gloomy Scale) (Fig. 45)

Scale of female: Circular, very convex, rough and about 1.5 mm. in diameter. Color similar to the bark on which it rests, or a very dark gray. Exuviae more or less central and surrounded by a light-colored ring.

Scale of male: Rather oval, smaller and similar in color to the female. Exuvia sublateral.

Plants found infested in Florida: Boxelder, gallberry, grape and maple.

Additional plants found infested elsewhere: Apple, cottonwood, hackberry, mulberry, oak and poplar.

Distribution in Florida: Fort Pierce, Gainesville, Glen Saint Mary, Macclenny, Perry and Tallahassee.

Distribution elsewhere: Arkansas, California, District of Columbia, Georgia, Kentucky, Mississippi, South Carolina, Texas.

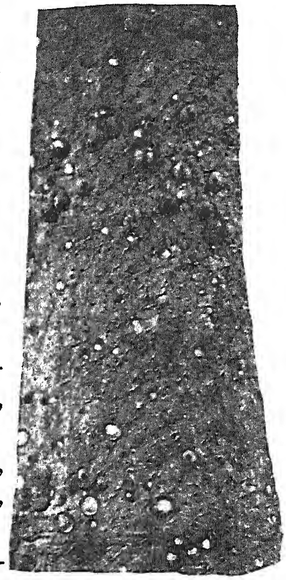


Fig. 45.—*Chrysomphalus tenebricosus* (Comst.) (Gloomy Scale) Slightly enlarged. (After Wilson)

37. *Comstockiella sabalis* (Comst.) (Palmetto Scale) (Fig. 46)

Scale of female: Circular or very irregular, especially when crowded. Varies from 1-1.5 mm. in diameter. Color, snow-white. Exuviae central, subcentral or occasionally marginal.

Scale of male: Irregularly oval and smaller than the female. Color snow-white. Exuvia subcentral.

Plants found infested in Florida: Palmettos (*Sabal* spp.) and various other palms.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: General.

Distribution elsewhere: California, Guadaloupe Island.

Remarks: This scale is not considered a serious pest.

38. *Cryptophyllaspis liquidambaris* Kotinsky (Sweet Gum Scale) (Fig. 47)

Gall of female: This consists of a small, rough, bluntly conical mound, almost invariably on the upper surface of a leaf, with an

open pit or hollow extending into it from the under side of the leaf. Each female lives within one of these pits. Height of gall .5-2 mm.; diameter at base generally about the same. Color light green or shading off to dark brown.

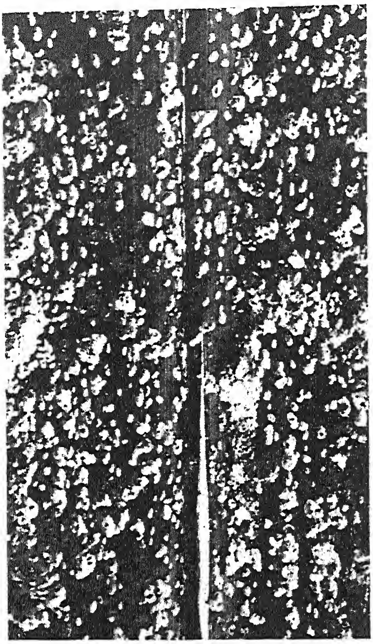


Fig. 46.—*Comstockiella sabalis* (Comst.) (Palmetto Scale) Enlarged twice. (After Wilson)

Scale of female: Circular or oval and about .75 mm. in diameter. Color white, parchment-like. Exuviae central or sub-central and yellow or yellowish brown in color.

Scale of male: Oval and about .5 mm. long. Exuvia subcentral and lemon-yellow in color. Scales usually found in groups of two or three in the narrower angle of the intersection of a vein and midrib of a leaf.

Plants found infested in Florida: Sweet gum *(Liquidambar styraciflua)* and red maple.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Bradentown, Gainesville, Lutz, Macclenny, New Smyrna and Palmetto.

Distribution elsewhere: District of Columbia, Georgia, Mississippi, Ohio.

Remarks: This scale is not regarded as a serious pest.

39. *Diaspis boisduvalii* Sign. (Boisduval's Scale) (Fig. 48)

Scale of female: Circular or somewhat ovate, variable, thin, flat and semitransparent. From 1.2-2.25 mm. in diameter. Color varying from white to light yellow. Exuviae central or subcentral; white or light yellow.

Scale of male: Oblong-oval and approximately 1 mm. long. Color white. Distinctly tricarinated. Exuvia terminal.

Plants found infested in Florida: *Aechmea* sp., *Billbergia* sp., caladiums, *Hohenbergia* sp., orchids, palms and pineapple.

Additional plants found infested elsewhere: *Acacia* spp., *Cattleya* sp., maranta and Spanish lime.

Distribution in Florida: Buena Vista, Clearwater, Daytona, DeLand, Estero, Fort Myers, Glen Saint Mary, Jacksonville, Key Biscayne, Little River, Miami, Oneco, Palm Beach, Pensacola, Pine Castle, Riverview, St. Petersburg, Tampa and West Palm Beach.

Distribution elsewhere: District of Columbia, Illinois, Indiana, Massachusetts, Mississippi, New Jersey, New York, Ohio, Tennessee; Australia, Bahama Islands, Brazil, Canada, Ceylon, Cuba, England, Europe, Guatemala, Hawaiian Islands, Jamaica, Mauritius, Mexico, New Zealand, Panama Canal Zone, Porto Rico, Portugal, South Africa, Uganda Protectorate, Virgin Islands, West Indies.

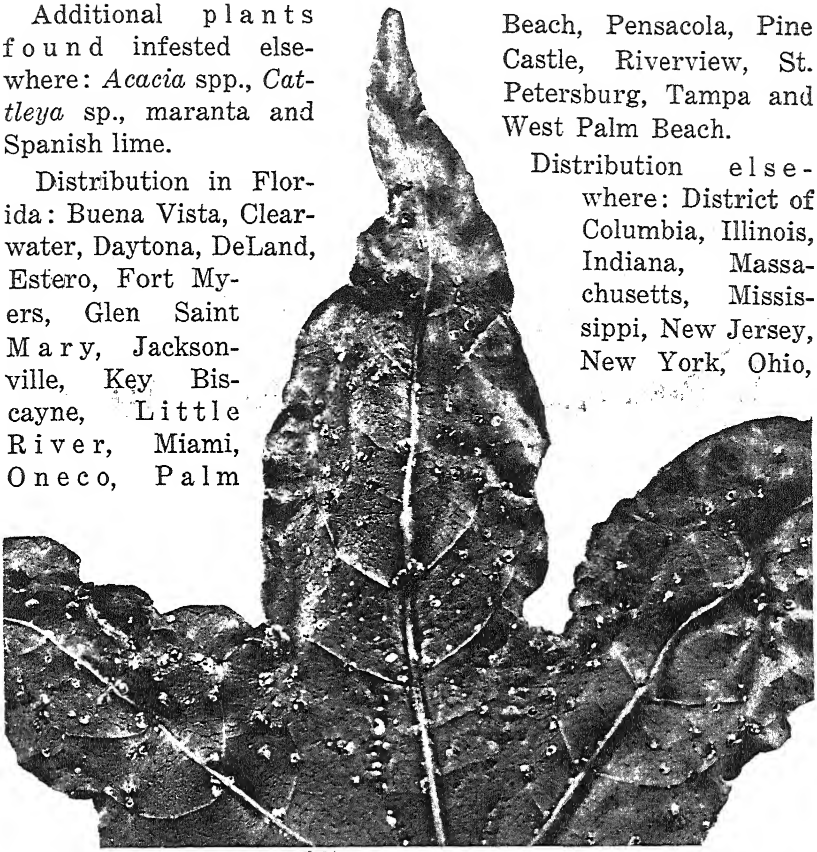


Fig. 47.—*Cryptophyllaspis liquidambaris* Kotinsky. (Sweet Gum Scale) Enlarged twice. (After Wilson)

Remarks: This scale occasionally becomes a serious pest.

40. *Diaspis bromeliae* (Kern.) (Pineapple Scale)
(Fig. 49)

Scale of female: Approximately circular, flat, semitransparent and varying from 2-3 mm. in diameter. Color yellowish white

or brownish yellow. Exuviae subcentral; yellow or pale brown in color.

Fig. 48.—*Diaspis boisduvalii* Sign. (Boisduval's Scale) Enlarged twice. (After Wilson)

Scale of male: About 1 mm. long. Altogether hardly separable from *Diaspis boisduvalii* Sign. as described above.

Plants found infested in Florida: Cactus and pineapple.

Additional plants found infested elsewhere: *Billbergia zebrina, Bromelia pinguin* (wild pine), canna, *Diocaena fragrans,* hibiscus, ivy and sweet olive.

Distribution in Florida: Clearwater, Fort Pierce, Gotha (?), Lucerne Park, Oneco, Orlando, Punta Gorda and Winter Haven.

Distribution elsewhere: California, District of Columbia, Illi-

nois, Massachusetts, Ohio; Cuba, England, Europe, Hawaii, Jamaica, Mexico, Seychelles, South Africa.

Remarks: This scale is not a serious pest in Florida.

Fig. 49.—*Diaspis bromeliae* (Kern.) (Pineapple Scale) Enlarged. (After Essig)

41. *Diaspis echinocacti cacti* Comst. (Cactus Scale) (Fig. 50)

Scale of female: Approximately circular, rather thin and varying from 1.5-2.25 mm. in diameter. Color varying from grayish white to greenish white. Exuviae central or subcentral; dark brown in color, usually covered with a whitish or grayish secretion.

Scale of male: About 1.25 mm. long by .25 mm. wide. Color white or greenish white. It has a more or less distinct median carina or ridge. Exuvia terminal.

Plants found infested in Florida: Cactus (several species).

Additional plants found infested elsewhere: Cactus (many species).

Distribution in Florida: Buena Vista, Florida Keys, Jacksonville, Key West, Miami, Punta Gorda and Tampa.

Distribution elsewhere: Arizona, California, Iowa, Massa-

chusetts, New Mexico, New York, Texas; Brazil, Cuba, India, Mauritius, Mexico.

Remarks: This scale is not considered a serious pest in Florida.

Fig. 50.—*Diaspis echinocacti cacti* Comst. (Cactus Scale) Enlarged twice. (After Wilson)

42. *Diaspis pentagona* (Targ.) (White Peach Scale) (Fig. 51)

Scale of female: Circular, but when crowded irregular; convex, thick, opaque. From 1-2.25 mm. in diameter. Color white, yellowish white or grayish white. Exuviae varying from central to almost marginal; orange-yellow or brick-red in color.

Scale of male: Shape elongate-oval and about 1 mm. long. Color white, but sometimes discolored. Exuvia terminal. There is usually a median carina, or ridge, which, at times, is nearly obscured.

Plants found infested in Florida: Ash, *Bahi fastigata,* cherry laurel, *Cercis canadensis,* Chinaberry, fig, geranium, holly, *Hypericum* sp., locust, mulberry, okra, olive, palm, peach, pecan, pepper, persimmon, plum, poplar, privet and walnut.

Additional plants found infested elsewhere: A large number of plants.

Distribution in Florida: Apalachicola, Callahan, Clearwater, Fernandina, Fort Pierce, Fruitville, Glen Saint Mary, Green Cove Springs, Groveland, Highland, Irvine, Jacksonville, Macclenny, Mayport, Miami, Orange Park, Starke, Tallahassee and Tampa.

Distribution elsewhere: Arkansas, California, District of Columbia, Georgia, Massachusetts, Mississippi, Ohio, South Carolina; Argentine, Australia, Austria, Brazil, British Columbia, Canada, Ceylon, China, Cuba, England, Europe, Fiji, Formosa, France, Hawaiian Islands, Italy, Jamaica, Japan, Mauritius, New Zealand, Panama, Panama Canal Zone, San Thome, Seychelles, South Africa, Spain, Switzerland, Uruguay, Virgin Islands, West Indies. Cosmopolitan.

Remarks: Becomes a very serious pest in some localities in Florida.

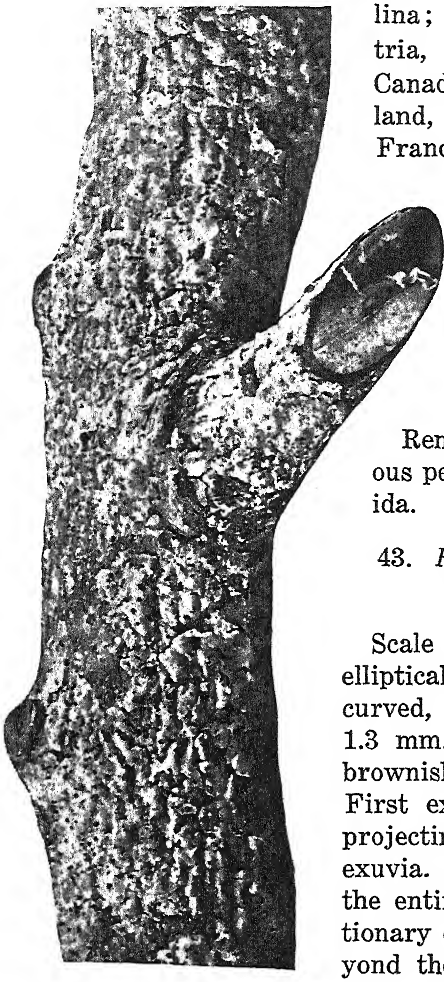


Fig. 51.—*Diaspis pentagona* (Targ.) (White Peach Scale) Enlarged twice. (After Wilson)

43. *Fiorinia fioriniae* (Targ.) (European Fiorinia)

Scale of female: Shape somewhat elliptical, sides more or less slightly curved, thin, shell-like and from 1-1.3 mm. long. Color varying from brownish yellow to orange-brown. First exuvia terminal, pale yellow, projecting partly beyond the second exuvia. Second exuvia covers nearly the entire scale. A very thin secretionary covering extends slightly beyond the second exuvia. A prominent central ridge runs longitudinally nearly the whole length of the second exuvia.

Scale of male: Unknown. Probably similar to *F. theae* described below.

Plants found infested in Florida: Avocado, bay, and palms.

Additional plants found infested elsewhere: *Camellia* sp., *Cycas* sp., cypress, English ivy, ferns, *Ficus* sp., *Leptospermum* sp., *Podocarpus* sp., etc.

Distribution in Florida: Boynton, Cape Florida, Delray, Hypoluxo, Little River, Miami, Orlando, Palm Beach and West Palm Beach.

Distribution elsewhere: Alabama, California, Colorado, District of Columbia, Louisiana, Maryland, Massachusetts, Algiers, Australia, Barbados, Brazil, Ceylon, China, Europe, Hawaiian Islands, Jamaica, Japan, Mauritius, Mexico, New South Wales, Peru, Philippine Islands, West Africa, Zanzibar.

Remarks: Not reported as of economic importance in Florida.

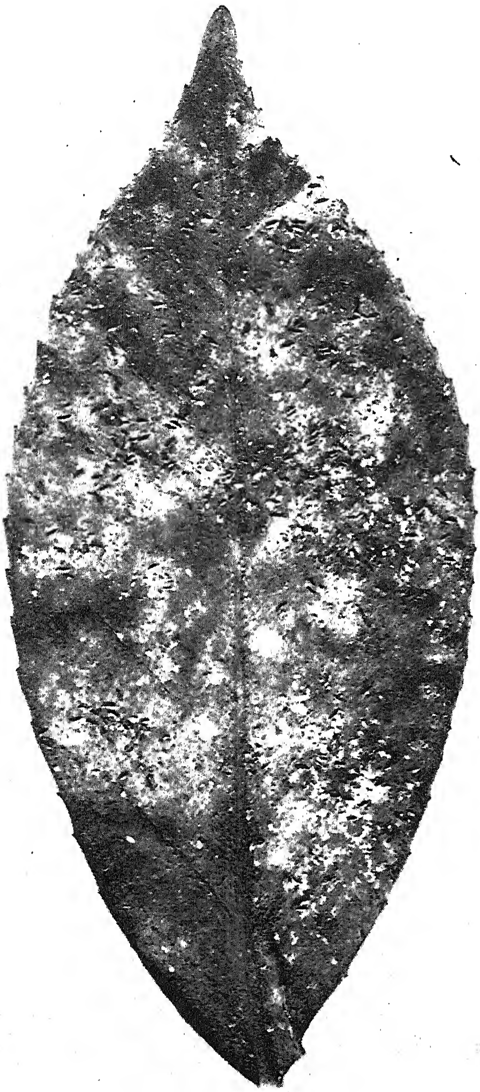


Fig. 52.—*Fiorinia theae* Green (Tea Scale) Enlarged about two times.

44. *Fiorinia theae* Green (Tea Scale) (Fig. 52)

Scale of female: Approximately oval, moderately thick, shell-like. Length varying from 1-1.3 mm.; width about .5 mm. Color varying from dark brown to almost black. First exuvia usually grayish, sometimes with a tinge of yellow, terminal. Second exuvia covers the entire insect, there being no apparent secretionary covering. There is a prominent central ridge lengthwise of the second exuvia.

Scale of male: Sides nearly parallel, ends rounded; about 1 mm. long. Color snow-white. Exuvia terminal and pale yellow in color. It is indistinctly tricarinated. When crowded the scales appear as though covered with a flocculent secretion.

Plants found infested in Florida: *Camellia japonica.*

Additional plants found infested elsewhere: *Caryola* sp., citrus, olive *(Olea glandulifera)*, *Ostodes* sp. and tea.

Distribution in Florida: Avon Park, Glen Saint Mary, Gotha, Jacksonville, Lakeland, Oneco, Sebring and Tallahassee.

Distribution elsewhere: Alabama, District of Columbia, Georgia, Louisiana, North Carolina, South Carolina; Ceylon, India, Philippine Islands.

Remarks: This scale often becomes a serious pest on camellias and requires frequent control measures.

45. *Gymnaspis aechmeae* Newstead
(Fig. 53)

Scale of female: Circular or very bluntly top-shaped, very convex and varying from .8-1.25 mm. in diameter. Color shining black or bronzy-black. Second exuvia apparently covering the scale insect. There is little, if any, secretionary covering. The first exuvia is lost during the second stage of the insect's life history.

Fig. 53.—*Gymnaspis aechmeae* Newstead. Greatly enlarged.

Scale of male: Oval in outline, and about .9 mm. long. Color black or purplish black. Exuvia sublateral.

Plants found infested in Florida: *Aechmea* sp., *Billbergia* sp., *Hohenbergia* sp., *Nidularium triste* and pineapple.

Additional plants found infested elsewhere: *Aechmea aquilega.*

Distribution in Florida: Gotha, Little River, Naples and Oviedo.

Distribution elsewhere: Brazil, England, Germany.

Remarks: This is a scale that should be closely watched in Florida.

46. *Hemichionaspis aspidistrae* (Sign.) (Fern Scale) (Fig. 54)

Scale of female: Oyster-shell or pear-shaped, rather flat and varying from 1.5-2.5 mm. long. Color pale brown, semitransparent. Exuviae terminal and similar in color to the scale.

Scale of male: Approximately parallel sided, slender and about 1 mm. long. Color white. Distinctly tricarinated (with three ridges). Exuvia terminal, pale yellow and about one-fourth the length of the scale.

Plants found infested in Florida: Asparagus fern, *Aspidistra lurida*, *Asplenium serratum*, cinnamon plant, *Cycas* sp., ferns, geranium, *Hibiscus* sp., orchid and palms.

Additional plants found infested elsewhere: *Acacia melanoxylon*, *Anthurium* sp., *Cordyline terminalis*, *Cyanotus* sp., *Davallia moorei*, fig, mango, orange, palms, *Pandanus* sp., pepper tree, soursop, etc.

Distribution in Florida: General.

Distribution elsewhere: California, Connecticut, District of Columbia, Georgia, Illinois, Indiana, Louisiana, Massachusetts, Mississippi, New Jersey, New York, Pennsylvania; Australia, Brazil, Canada, Canal Zone, Ceylon, Chili, Cuba, England, Formosa, France, Holland, India, Jamaica, Japan, Philippine Islands, Porto Rico, Portugal, Seychelles, South Africa, Spain, Trinidad.

Remarks: Its economic importance is questionable.

47. *Hemichionaspis minor* (Mask.) (Lesser Snow Scale) (Fig. 55)

Scale of female: Irregularly pear or oyster-shell-shaped, flat, tough and from 1.5-2.5 mm. long. Color white or dirty white, semitransparent. Exuviae terminal, yellowish brown in color.

Scale of male: Nearly parallel-sided and about 1 mm. long. Color white. Distinctly tricarinated (three ridged). Exuvia terminal, fulvous in color.

Plants found infested in Florida: *Abutilon* sp., asparagus fern, Australian silk oak, avocado, *Bahi fastigata, Bignonia* sp., boxwood, cactus, caladium, camphor, cassava, *Cassia abata,* castor bean, century plant, *Cestrum diurnum,* Chinaberry *(Melia Azedarach),* citrus, cotton, croton, *Cycas* sp., fig, frangipanni, grape, hackberry, hemp, *Hibiscus* sp., hollyhock, hypocrite plant, mango, *Mesembryanthemum* sp., morning-glory, mountain ebony *(Bauhinia purpurea),* oleander, palms, paradise vine, *Parkinsonia* sp., pepper tree, *Persea* sp., pigeon pea, *Pilea* sp., pink vine, *Pittosporum* sp., royal poinciana, sapodilla, scarlet bush, *Schizolobium excelsum, Severinia buxifolia, Solanum windlandii,* soursop, spider lily, sumac, sweet potato, *Symphoricarpos* sp., *Thunbergia grandiflora, Vitis quadrangularis,* Wisteria and woodbine.

Fig. 54. — *Hemichionaspis aspidistrae* (Sign.) (Fern Scale) Enlarged twice. (After Wilson)

Fig. 55. — *Hemichionaspis minor* (Mask.) (Lesser Snow Scale) Natural size. (After Wilson)

Additional plants found infested elsewhere: *Albizzia stipulata, Bryophyllum* sp., ceiba, *Ficus* sp., Japanese lantern plant, *Melia Azedarach, Parsonia* sp., *Pelargonum* sp., *Pithecolobium saman, Rhipogonum scandeus,* sugar apple, etc.

Distribution in Florida: General.

Distribution elsewhere: Antigua, Bahama Islands, Brazil, British Guiana, British West Indies, Ceylon, Colombia, Cuba, Gold Coast (Africa), Grenada, Isle of Pines, Jamaica, Japan, New Zealand, Panama, Porto Rico, West Africa, West Indies, Zanzibar.

Remarks: This scale is of economic importance in Florida.

48. *Howardia biclavis* (Comst.) (Mining Scale) (Fig. 56)

Scale of female: Approximately circular, rather heavy in texture, moderately convex and varying

from 2-2.5 mm. in diameter. Color whitish, grayish or yellowish. Owing to the fact that this scale is partly mining in nature, the

Fig. 56.—*Howardia biclavis* (Comst.) (Mining Scale) Natural size. (After Wilson)

scale is covered with the outer layers of the bark, and in consequence, is the color of the bark to all outward appearances. Exuviae terminal.

Scale of male: Unknown.

Plants found infested in Florida: *Andira jamaicensis*, Australian pine, Australian silk oak, *Bignonia* sp., *Casuarina stricta*, chinquapin, cinnamon jasmine or false ylang-ylang, *Ficus* spp., honeysuckle, *Ixora* sp., *Jacobinia spicigera*, lion's tail *(Leonotis leonurus)*, *Peltophorum* sp., sapodilla, scarlet bush, *Tabernaemontana* sp., *Tecoma* sp., white sapota, Wisteria and *Ziziphus* sp.

Additional plants found infested elsewhere: Acalypha, *Anona* spp., *Bixa orellano*, caymito, *Citrus* spp., coffee, *Duranthez* sp., *Ficus religiosa*, fig, jessamine, *Lucuma nervosa*, *Mammea* spp., *Microglossa zelandica*, papaya, poinsettia, pomegranate, privet, *Raphiolepis* spp., soursop, star apple, *Stephanotus* sp., sugar apple, tamarind, tea and *Trichelia* sp.

Distribution in Florida: Bradentown, Clearwater, Coconut Grove, Fort Pierce, Jacksonville (?), Key West, Lakeland, Miami, Oneco, Palma Sola, Pensacola, Redland and St. Petersburg.

Distribution elsewhere: California, District of Columbia, Kansas, Ohio; Bahama Islands, Ceylon, Costa Rica, Cuba, England, Hawaiian Islands, Ireland, Italy, Japan, Mauritius, Mexico, Panama Canal Zone, Porto Rico, Tahiti, South Africa, West Indies.

Remarks: This scale is considered quite a serious pest.

49. *Ischnaspis longirostris* (Sign.) (Black Thread Scale) (Fig. 57)

Scale of female: Long, narrow, thread-like, parallel-sided, very convex and from 2-3.5 mm. long. Color shining black. The scales may be straight or curved. Exuviae terminal, brownish in color.

Scale of male: Unknown.

Plants found infested in Florida: *Aechmea* sp., *Andira jamaicensis*, asparagus fern, *Bignonia* spp., coffee, *Cycas* sp., ferns, *Ficus benjamina*, *Ficus retusa*, *Ixora parviflora*, *Lonicera rubri-*

flora, mango, *Monstera deliciosa* (Ceriman), palms, *Pandanus* sp., pink vine, *Randia* sp. and rubber.

Fig. 57.--*Ischnaspis longirostris* (Sign.) (Black Thread Scale) Slightly enlarged. (After Wilson)

Additional plants found infested elsewhere: *Chaetachme aristata, Citrus* spp., *Dracaena australis, Ficus* sp., jasmine, *Magnolia grandiflora* and palmetto.

Distribution in Florida: Buena Vista, Coconut Grove, Jacksonville, Key Biscayne, Larkins, Little River, Miami, Miami Beach, Oneco, Orlando, Palm Beach, St. Petersburg and West Palm Beach.

Distribution elsewhere: California, Connecticut, District of Columbia, New York; Australia, British West Indies, Brazil, Ceylon, Cuba, Demerara, Great Britain, Jamaica, Japan, New Zealand, Panama, San Thome, Seychelles, South Africa, Uganda Protectorate (Africa), West Indies.

Remarks: Occasionally becomes a very serious pest on palms and sagos.

50. *Lepidosaphes alba* (Ckll.)

Scale of female: Oyster-shell-shaped (see figure 16 B), straight or curved, rather convex, and varying from 1.75-2.5 mm. long. Color pale grayish white or pale brownish white. Exuviae terminal, slightly darker in color than the remainder of the scale.

Scale of male: Similar to female, smaller, narrower and varying from 1-1.25 mm. long. Exuvia terminal.

Plants found infested in Florida: Dog fennel and *Manihot aipi.*

Additional plants found infested elsewhere: Cassava and *Solanum* spp.

Distribution in Florida: Key Biscayne and Lake City.

Distribution elsewhere: New Mexico, Bahama Islands, Cuba, Jamaica, Mexico.

Remarks: This scale is of very little economic importance.

51. *Lepidosaphes beckii* (Newm.) (Purple Scale)
(Fig. 58)

Scale of female: Elongated, pear or oyster-shell-shaped, straight or curved, moderately or slightly convex. From 2-3 mm. long. Color purplish or dark brown, extreme margins somewhat lighter. Texture of scale rather heavy. Exuviae terminal. Second exuvia about one-third or one-fourth the length of the scale. First exuvia very short.

Scale of male: Narrower, straighter and about one-half as long as the female scale. Color frequently decidedly more purplish

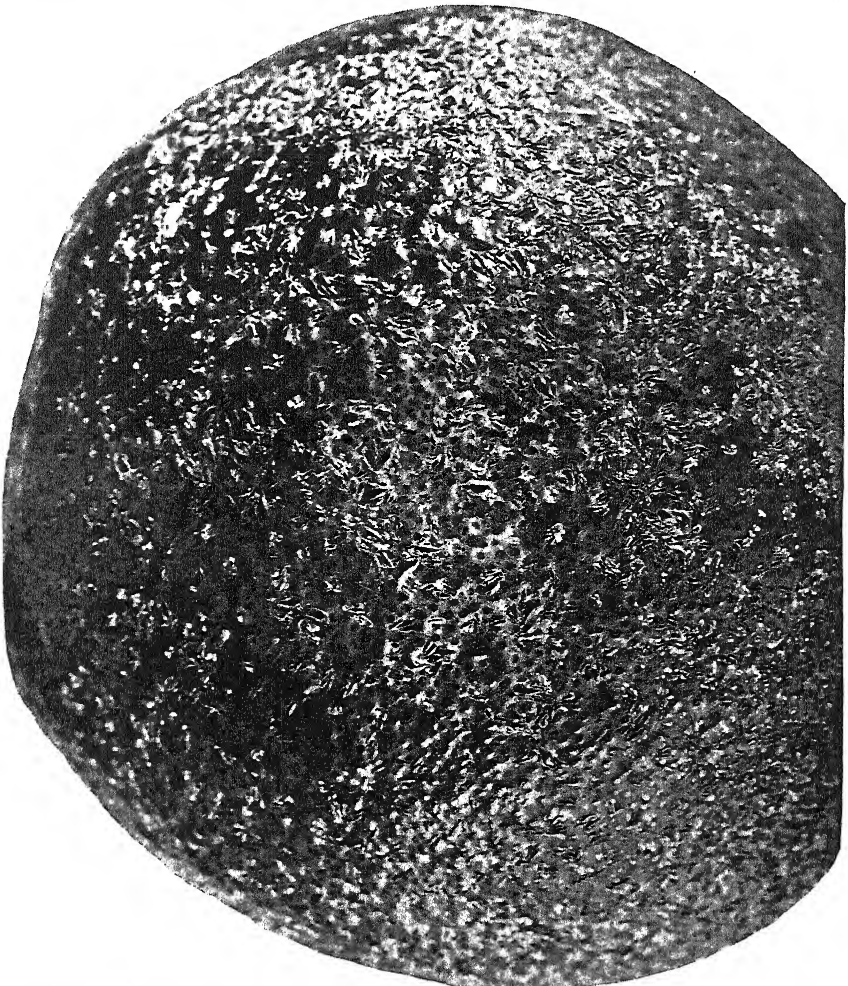


Fig. 58.—*Lepidosaphes beckii* (Newm.) (Purple Scale) Enlarged twice. (After Wilson)

than female, at other times like female or lighter. Exuvia terminal. See figure 17 C.

Plants found infested in Florida: *Allamanda* sp., bergamont, California privet, Chinese holly, *Citrus* spp., *Cycas* sp., *Elaeagnus* sp., magnolia, mango, mistletoe, oak, orange jessamine, palm, pecan and Spanish bayonet.

Additional plants found infested elsewhere: *Banksia integrifolia, Cercidiphyllum japonicum,* croton, fig, *Murraya* sp., *Pomaderris apetala, Taxus cuspidata,* etc.

Distribution in Florida: General.

Distribution elsewhere: Alabama, Arizona, California, Colorado, Connecticut, Georgia, Indiana, Kansas, Louisiana, Ohio, South Carolina, Texas; Africa, Antigua, Argentina, Australia, Bahama Islands, Bermuda, British Honduras, British West Indies, Canary Islands, Ceylon, Chili, Costa Rica, Cuba, Dominica, Europe, Fiji, Formosa, France, Grenada, Hawaiian Islands, Isle of Pines, Italy, Indo-China, Jamaica, Japan, Madeira, Mauritius, Mexico, Morocco, New Zealand, Nicaragua, Panama Canal Zone, Porto Rico, Portgual, San Thome, Seychelles, Spain, South Africa, Tasmania, Uganda Protectorate, West Africa, West Indies, Zanzibar, etc. Cosmopolitan.

Remarks: This scale is a very serious pest, especially on citrus, and requires constant control measures.

52. *Lepidosaphes camelliae* Hoke (Camellia Scale) (Fig. 59)

Scale of female: Oyster-shell-shaped, slightly convex, median line straight (curved when crowded), about 2.5 mm. long and 1 mm. wide near posterior end. Color usually light or moderately dark brown. Exuviae terminal. Second exuvia approximating one-third the length of the scale.

Scale of male: Similar to that of the female, narrower and shorter. Color light brown with a polished coppery tinge. Exuvia terminal and with a greenish golden tinge in clean specimens.

Plants found infested in Florida: *Camellia japonica.*

Plants found infested eslewhere: *Camellia japonica.*

Distribution in Florida: Glen Saint Mary, Pensacola, Sebring, Tallahassee and Tampa.

Distribution elsewhere: Alabama, Georgia, Mississippi, South Carolina.

Remarks: This scale occasionally becomes quite a serious pest. From outward appearances it resembles Purple Scale.

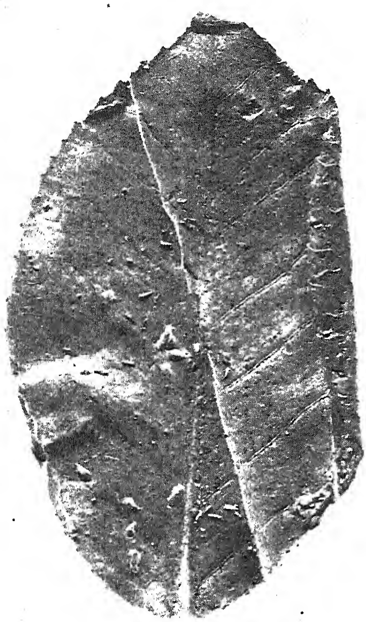


Fig. 59. — *Lepidosaphes camelliae* Hoke. (Camellia Scale) Slightly enlarged.

53. *Lepidosaphes dentata* (Hoke)

Scale of female: Extremely long and slender, length from 1-1.5 mm. and about one-eighth to one-fourth as wide; parallel-sided. Color white with a tinge of yellowish green. Exuviae terminal. Second exuvia equal or slightly less than one-half the length of the scale.

Scale of male: Shorter and broader than the female and similar in color. Exuvia terminal.

Plants found infested in Florida: Oak and white Chinese whist.

Additional plants found infested elsewhere: *Asparagus sprengeri*, black haw *(Bumelia lanuginosa)* and maple.

Distribution in Florida: Eustis, Hudson, Oneco and Sebring.

Distribution elsewhere: Mississippi.

Remarks: This scale is of little economic importance.

54. *Lepidosaphes gloverii* (Pack.) (Long or Glover's Scale) (Fig. 60)

Scale of female: Very long, narrow, with the sides nearly parallel, straight or curved. From 2.5-3.25 mm. long and about one-fifth as wide. Color varying from brownish yellow to dark brown, or variable, margins somewhat lighter. Exuviae terminal and of a yellowish color.

Scale of male: Smaller, otherwise similar to the female and about 1.5 mm. long. Exuvia terminal.

Plants found infested in Florida: Cabbage palmetto, cherry laurel, citrus and magnolia.

Additional plants found infested elsewhere: Palms.

Distribution in Florida: General.

Distribution elsewhere: California, Middle and Southern United States; Australia, Central America, Ceylon, China, Cuba, France, Germany, Hawaiian Islands, Holland, India, Japan, Lower California, Mauritius, Mexico, Philippines, South Africa, South America, Spain, Uganda Protectorate.

Remarks: This scale is frequently a serious pest of citrus.

Fig. 60. — *Lepidosaphes gloverii* (Pack.) (Long, or Glover's Scale) Enlarged four times.

55. *Lepidosaphes hawaiiensis* (Mask.)

Scale of female: In shape, rather the oyster-shell type of scale, but being fitted into the indentations of the bark makes it appear rather irregular. It is thin, flat and more or less transparent. Length, from 1.5-4 mm. Color varies from pale brown to dark brown. Exuviae terminal, rather dull copper-colored and about one-fourth the length of the scale. The scale is nearly covered with the outer layers of the bark.

Scale of male: Similar to the female, about one-half its length. Color similar. Exuvia terminal.

Plants found infested in Florida: Lawsonia.

Additional plants found infested elsewhere: *Lagerstroemia indica*, orange, *Pyrus sinensis* and soursop.

Distribution in Florida: Oneco.

Distribution elsewhere: China, Cuba, Gold Coast (Africa), Hawaii, Samoa, South Africa, West Africa.

Remarks: This scale may prove to be a serious pest in Florida.

Lepidosaphes nigra (Ckll.)

Remarks: The original material determined as this species, by C. E. Wil-

son, has been thoroughly gone over and found to be nothing other than *L. dentata* (Hoke). Bibliographical records should be corrected.

56. *Lepidosaphes ulmi* (Linn.) (Oyster-shell Scale)

(Fig. 61)

Fig. 61.—*Lepidosaphes ulmi* (Linn.) (Oyster-shell Scale) Enlarged twice. (After Wilson)

Scale of female: Oyster-shell-shaped, straight or curved, either long and slender or comparatively short and broad; rather convex, thick and with dune-like, curved ridges transversely across the secreted portion. Length, from 1.5-3 mm. Color varies from chestnut-brown to a very dark brown. Exuviae terminal, coppery-brown and, at times, about one-third the length of the scale.

Scale of male: Similar in shape and color to the female. Length about 1 mm. Exuvia terminal.

Plants found infested in Florida: Fig and peach.

Additional plants found infested elsewhere: *Aesculus glabra, Ailanthus glandulosa,* apple, ash, birch, bladder-nut, butter-nut, *Ceanothus americanus, Cornus* sp., currant, *Cytisus* sp., dogwood (red osier), elm, hawthorn, hop tree, horse chestnut, lilac, linden, maple, oak, pear, peony, poplar, raspberry, rose, *Sassafras variifolium, Stillingia sebiferum, Syringa persica,* water locust, wild cherry, willow, *Yucca* sp., etc.

Distribution in Florida: Jacksonville and Macclenny.

Distribution elsewhere: United States, Algeria, Australia, Austria, Brazil, British East Africa, Canada, Denmark, England, Europe, France, Germany, Hawaiian Islands, Holland, Italy, Japan, Macedonia, New Zealand, Norway, Russia, Sweden, Switzerland, South France, Victoria.

Remarks: This scale is not a serious pest in Florida.

57. *Leucaspis bambusae* Kuw.
(Fig. 62)

Scale of female: Long, slender, sides approximately parallel but tending to diverge away from the exuviae; convex and moderately thick. Length from 2-3 mm. Color usually white, sometimes a dirty white. Exuviae terminal, light brown or copper-colored.

Scale of male: Approximately oblong and about .75 mm. long. Color white. More or less distinctly tricarinated. Exuvia terminal and light brown or copper-colored.

Plants found infested in Florida: Bamboo.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Brooksville, Fruitland Park, Glen Saint Mary, Miami and South Jacksonville.

Distribution elsewhere: New Jersey; Japan.

Remarks: The economic importance of this scale is questionable.

58. *Leucaspis indica* Marlatt (Mango Scale)

Scale of female: Long, narrow, very convex and very thin, compressed cottony or wax-like, flattened at tip. From .5-1 mm. in length. Color white. First exuvia terminal. Second exuvia entirely surrounds the scale insect causing it to appear like a very small seed or egg. The whitish compressed cottony or wax-like material fits loosely over the exuviae and is often absent because the slightest friction will rub it off.

Scale of male: Not known.

Plants found infested in Florida: Mango.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Buena Vista, Miami, Oneco and West Palm Beach.

Distribution elsewhere: Hawaii, India, Porto Rico.

Remarks: This scale is generally found massed in crevices or under loose bark. Probably of economic importance on mango.

Fig. 62.—*Leucaspis bambusae* Kuw. Enlarged twice. (After Wilson)

59. *Odonaspis ruthae* Kotinsky (Bermuda Grass Odonaspis)

Scale of female: Oval or nearly circular, moderately convex. From 1-1.75 mm. in diameter. Color pure white. Exuviae approximately one-third the length of the scale and located at or near the end; straw-colored and either partly or wholly covered with a whitish secretion. Ventral scale white.

Scale of male: Approximately one-half the size of the female and similar in color. Exuvia sublateral.

Plants found infested in Florida: Bermuda grass.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Gainesville and Lake Gem.

Distribution elsewhere: Louisiana; Ceylon, Hawaii.

Remarks: This species is not of economic importance. It is usually found in the leaf axils in the loose soil at the surface of the ground.

60. *Parlatoria pergandii* Comst. (Chaff Scale)
(Fig. 63)

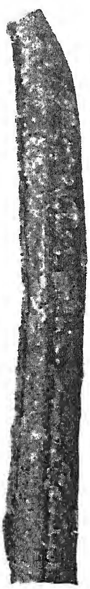


Fig. 63. — *Parlatoria pergandii* Comst. (Chaff Scale) Enlarged twice. (After Wilson)

Scale of female: Very variable in shape, from irregularly rounded to irregularly oblong. Rather thin, more or less transparent and slick. Length from 1-1.75 mm. Color of a dirty brown or brownish gray. Exuviae central or subcentral, yellowish or orange-brown in color.

Scale of male: Similar but smaller than the female. Color brownish or purplish brown. Exuvia marginal and somewhat straw colored.

Plants found infested in Florida: *Aleurites Fordii* (Chinese oil nut), asparagus fern, camellia, camphor, *Carissa* sp., cinnamon, *Citrus* spp., croton, *Cycas* sp., *Eugenia* sp., *Euonymus* sp., *Ficus* spp., guava, jasmine, mango, oleander, palms, sweet olive, *Viburnum* sp. and wandering Jew.

Additional plants found infested elsewhere: Canistel.

Distribution in Florida: General.

Distribution elsewhere: Alabama, California, Connecticut, District of Columbia, Georgia, Indiana, Kansas, Louisiana, Maryland, Massachusetts, Mississippi, New Jersey, Ohio, Pennsylvania, Texas; Algeria, British Honduras, Cuba, England, Europe, France,

Germany, Hawaiian Islands, Ireland, India, Isle of Pines, Italy, Japan, Mexico, Philippine Islands, Seychelles, South Africa, South America, Spain, Spanish Honduras, etc. Probably cosmopolitan.

Remarks: At times, quite a severe pest on citrus.

61. *Parlatoria proteus* (Curtis)

Scale of female: Elongate-oval, convex, transparent. From 1-2 mm. in length. Color, pale greenish or grayish yellow, margins lighter. Exuviae marginal, yellowish or brownish in color. Second exuvia often about one-third the length of the scale.

Scale of male: Elongate, sides parallel and about 1 mm. long. Exuvia marginal and yellowish in color.

Plants found infested in Florida: Avocado, *Camellia* sp., *Carissa bispinosa, Cycas* sp., *Elaeagnus simonii,* English ivy, ferns, *Ficus* sp., flame vine, magnolia, monkey puzzle tree, oleander, orchid, palms, *Pandanus* sp., *Passiflora* sp., rose apple, sapodilla and *Thunbergia grandiflora.*

Additional plants found infested elsewhere: Apple, date palm, citrus, machilus, *Macrozamia* sp., myrtle, *Pinus insignis* and *Selenipedium* sp.

Distribution in Florida: Clearwater, Daytona, Eustis, Fort Myers, Glen Saint Mary, Jacksonville, Lakeland, Little River, Miami, New Port Richey, Oneco, Orlando, Palm Beach, Riverview, St. Petersburg, Tampa and West Palm Beach.

Distribution elsewhere: District of Columbia, Illinois, Kansas, New York; Australia, Brazil, Ceylon, China, Europe, Formosa, Hawaii, Japan, South Africa.

Remarks: This scale is quite a serious pest on ornamental plants.

62. *Phenacaspis nyssae* (Comst.) (Sour-gum Scale)

Scale of female: "Length 1-1.5 mm.; usually strongly broadened behind, almost triangular, flat, snowy white, delicate; exuviae nearly one-half the total length of the scale in some cases; ventral scale very thin and delicate, hardly visible."

Scale of male: "Length 1-1.25 mm.; elongate, slender, parallel-sided, snow white, distinctly tricarinate; exuvia from one-fifth to one-third the total length of the scale."

Plants found infested in Florida: *Nyssa biflora* (water gum).

Additional plants found infested elsewhere: *Nyssa sylvatica* (black gum).

Distribution in Florida: Winter Haven.

Distribution elsewhere: Georgia, North Carolina.

Remarks: The above description is taken from Dietz and Morrison (Eighth Annual Report of the Indiana State Entomologist (1914-1915) p. 276). This scale is not of economic importance.

63. *Pinnaspis buxi* (Bouche)

Scale of female: Nearly pear-shaped, slightly convex, thin, semitransparent and varying from 1-1.5 mm. long. Color, light or dark reddish brown or grayish brown. Exuviae terminal and yellow in color.

Scale of male: Not known.

Plants found infested in Florida: Pandanus.

Additional plants found infested elsewhere: *Anthurium crystallinium*, *Areca lutescens*, box tree *(Buxus sempervirens)*, coconut palm, *Dictyosperma alba*, *Dracaena* sp., *Pandanus conoideus* and *Thrinax excelsa*.

Distribution in Florida: Miami.

Distribution elsewhere: District of Columbia, Illinois, Massachusetts, New York; Barbados, Brazil, British Guiana, British Honduras, Dominica, East Africa, England, Europe, Germany, Grenada, Jamaica, Panama, Seychelles, Togoland, Trinidad, West Indies.

Remarks: This scale should be watched. Its present status is questionable.

64. *Pseudaonidia articulatus* (Morg.) (Rufous Scale) (Fig. 64)

Scale of female: Approximately circular, slightly convex, more or less semitransparent and varying from 2-2.5 mm. in diameter. Color, variable, from grayish brown to yellowish brown; marginal portion distinctly lighter. Exuviae more or less central, yellowish or copper-colored. Second exuvia equals about one-third the diameter of the scale. Marginal portion of scale much less transparent than the central portion.

Scale of male: Oval and about 1.25 mm. in length. Color lighter than female. Exuvia sublateral and deeper yellow in color than in the female.

Plants found infested in Florida: Avocado, *Brunfelsia nitida*, citrus, gumbo limbo, hog plum *(Spondias purpurea)*, jasmine, oleander, *Pandanus* sp., poison wood, pomegranate, rose, sapodilla and Spanish lime.

Additional plants found infested elsewhere: Acalypha, banana, caladium, coffee, *Cordyline terminalis*, croton, *Ficus* sp., *Gardenia* sp., *Laurel indica, Mammea* sp., palms, screw pine, soursop, spice, star apple, sugar apple, *Tabernaemontana* sp., tamarind and "tieza".

Distribution in Florida: Key West and Miami.

Distribution elsewhere: Bahama Islands, Brazil, British West Indies, Costa Rica, Cuba, Demerara, England, Mexico, Nicaragua, Panama, Philippines, Spanish Honduras, South Africa, Uganda Protectorate, West Africa, West Indies.

Remarks: This scale is usually a very serious pest.

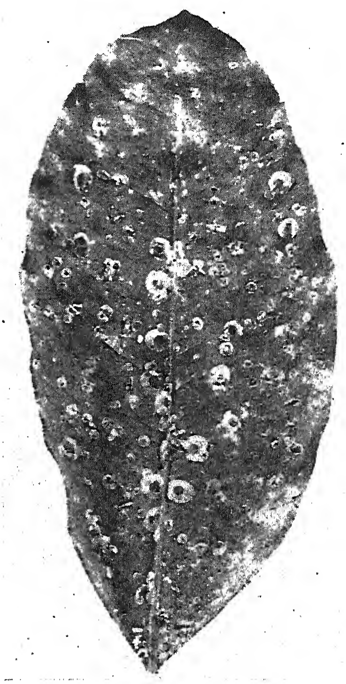


Fig. 64. — *Pseudaonidia articulatus* (Morg.) (Rufous Scale) Enlarged twice. (After Wilson)

65. *Pseudaonidia tesserata* (de Charm.)

Scale of female: Approximately circular, occasionally oval, having a curvature similar to that of half a navy bean. About 2.5 mm. in diameter. The under side of the scale is dull reddish brown with a sprinkling of white powder-like material toward the center. The ventral scale, or subscale, just underneath the insect and next to the bark, is lighter in color than the dorsal (upper) scale (or scale proper). This subscale is covered to a greater or lesser extent with a white powdery, wax-like material. Exuviae more or less central. The scale is nearly always covered by the outer layers of the bark.

Scale of male: Much smaller than the female, sides more or less parallel. Exuvia sublateral.

Plants found infested in Florida: White hibiscus.

Additional plants found infested elsewhere: Acalypha, grapevine, *Leucaena glauca*, Malvaviscus, palm and *Prunus* sp.

Distribution in Florida: Oneco.

Distribution elsewhere: Antigua, Bahama Islands, Cuba, Isle of Pines, Jamaica, Java, Mauritius, Mexico, Porto Rico.

Remarks: This scale is occasionally intercepted at ports of entry in shipments from the Bahama Islands, Cuba and the Isle of Pines. Judged by the behavior of its near relatives, which invariably are pests of prime importance and difficult to control where firmly established, every effort should be made to prevent its further introduction and distribution in the state.

66. *Pseudischnaspis alienus* (Newstead) (Alien Scale) (Fig. 65)

Scale of female: Elongate-oblong shaped, sides approximately parallel, straight or curved, moderately convex, shell-like in texture, and with curved ridges transversely across secreted portions. Length 2-3 mm. and width 1-1.25 mm. Color usually blackish but covered with a purplish brown or bluish gray powder-like substance. Exuviae rather large, marginal or submarginal, brownish black and with a grayish, circular nipple-like portion surrounding the first exuvia.

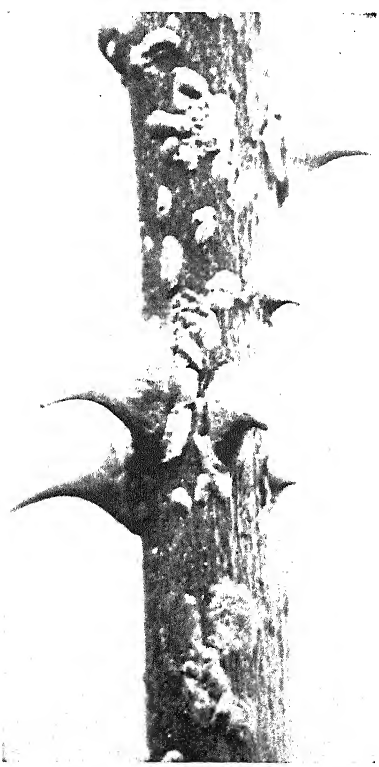


Fig. 65. — *Pseudischnaspis alienus* (Newst.) (Alien Scale) Greatly enlarged.

Scale of male: Similar to female. Length about 1 mm., width about .33 mm. Exuvia marginal or submarginal and brown or black in color.

Plants found infested in Florida: Jessamine and rose.

Additional plants found infested elsewhere: Avocado, Australian silk oak, caimito, Caladium, *Cassia obtusifolia*, *Cattleya Skinneri*, Chinaberry, *Clerodendron* sp., *Datura arborea*,

guava, Jamaica apple, *Mammea* sp., *Milliflores verbenacia, Muchlenbeckia platyclada,* mulberry, palm, *Salix bablionica,* Spanish bayonet, Spanish lime, sugar apple and *Yucca gloriosa.*

Distribution in Florida: Key West and Miami.

Distribution elsewhere: Cuba, England.

Remarks: This scale is a very serious pest in the tropics and subtropics. Study of other species in this genus may relegate the material at hand to one of them.

67. *Pseudoparlatoria parlatorioides* (Comst.) (Parlatoria-like Scale) (Fig. 66)

Scale of female: Approximately circular, flat or moderately convex, thin, parchment-like and varying from .75-1.5 mm. in diameter. Color varying from smoky black to yellowish gray. Exuviae usually marginal, large and amber colored.

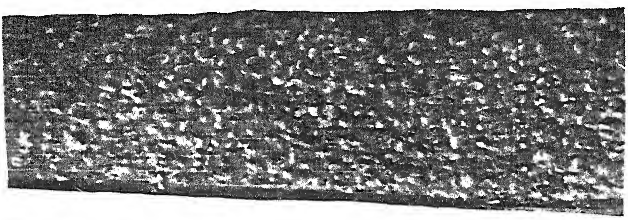


Fig. 66.—*Pseudoparlatoria parlatorioides* (Comst.) (Parlatoria-like Scale) Enlarged twice. (After Wilson)

Scale of male: Elongate-oval, and approximately .75 mm. long by about .4 mm. wide. Color, in specimens at hand, smoky brown. Exuvia terminal and yellow in color.

Plants found infested in Florida: *Acalypha* sp., avocado, bay, *Bignonia* sp., blackberry, blueberry, camphor, comptie, flame vine, horsebriar, magnolia, orchid and palms.

Additional plants found infested elsewhere: *Asclepias sublata, Cercidium* sp., croton, *Drimys* sp., *Elaphrium microphyllum, Forchammeria watsoni,* hibiscus, oleander, *Oncidium varicosum,* peach and *Psidium* sp.

Distribution in Florida: Aurantia, Brooksville, Cape Florida, Clermont, Delray, Fort Myers, Fort Pierce, Grant, Hypoluxo, Key West, Lake Hamilton, Leesburg, Lynne, Manatee, Miami,

Ocala, Oneco, Palm Beach, Paradise, St. Augustine, St. Petersburg, Sarasota, Sebring, Sneed's Island and West Palm Beach.

Distribution elsewhere: South Carolina; Bahama Islands, Brazil, Cuba, Germany, Italy, Lower California, Mexico.

Remarks: This scale is occasionally a very serious pest, especially on acalypha and palms.

68. *Targionia dearnessi* (Ckll.)
(Fig. 67)

Scale of female: Oval, rather convex, opaque, and from 1-2 mm. long. Color very light brownish white. Exuviae subcentral, yellow and usually covered with a white secretion.

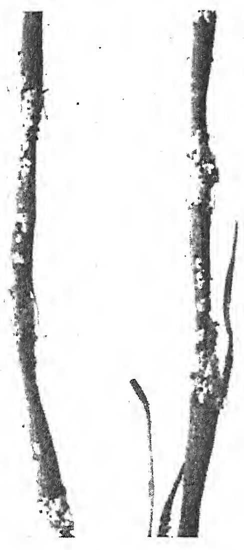


Fig. 67.—*Targionia dearnessi* (Ckll.) Enlarged four times.

Scale of male: Similar to female and about .75 mm. long by about .2 mm. in width. Exuvia sublateral, light yellow in color and usually covered with a white secretion.

Plants found infested in Florida: Summer farewell *(Kuhnistera pinnata)* and some unknown weeds.

Additional plants found infested elsewhere: Bearberry *(Arctostaphylos Uva-ursi)*.

Distribution in Florida: Gainesville, Miami and Palm Beach.

Distribution elsewhere: California, Bruce Peninsula, shores of Lake Huron; Canada.

Remarks: This scale is of no economic importance.

69. *Targionia quohogiformis* Merrill (Quohog-shaped Scale)
(Fig. 68)

Scale of female: Oval and very similar to that of the Round Clam *(Venus mercenaria)* commonly called Quohog. Length varying from 1-1.4 mm. and nearly one-half as thick. The dorsal

(upper) and ventral (lower) scales are placed more or less laterally, the ventral being unusually developed and forming with the dorsal a bivalve-like arrangement. The union of dorsal and ventral scales is very weak, with the outer edges sometimes slightly apart. Color, rather brownish, upper edges generally being somewhat lighter. The surface sprinkled with apparently very fine sand-like material. Exuviae subcentral and ringed with a whitish secretion. The exuviae also generally serve as the dorsal contact point with the bark while that portion of the ventral scale near the proboscis (beak) serves as the contact point with the bud. These scales are, furthermore, invariably attached at or very near the junction of a bud and branch.

Scale of male: Not known.

Plants found infested in Florida: Australian silk oak, blue trumpet *(Bignonia speciosa)*, mountain ebony, queen's wreath *(Petraea volubilis)* and wild mulberry.

Additional plants found infested elsewhere: Croton and custard apple.

Distribution in Florida: Coconut Grove, Miami, Oneco and Palm Beach.

Distribution elsewhere: Cuba, and St. Lucie Island in the British West Indies.

Remarks: Probably not of economic importance.

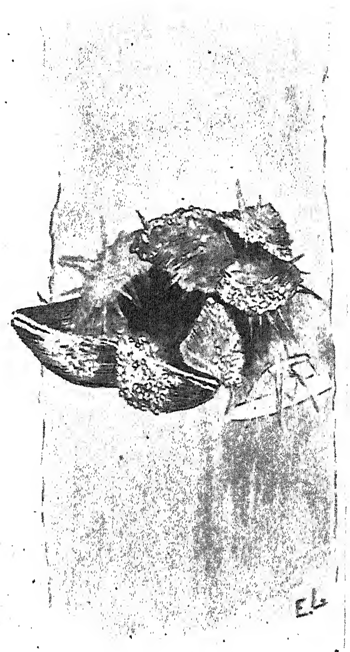


Fig. 68. — *Targionia quohogiformis* Merrill (Quohog-shaped Scale) Greatly enlarged. (After Merrill)

70. *Targionia sacchari* (Ckll.) (Sugar-cane Scale) (Fig. 69)

Scale of female: Approximately circular, convex, opaque and varying from .75-1.25 mm. in diameter. Color, light grayish brown or slightly purplish brown. Exuviae central or subcen-

tral, more or less covered with secretion and light yellow in color.

Scale of male: Similar to that of the female and about .75 mm. long by about one-third as wide. Exuvia rather marginal and light yellow in color.

Plants found infested in Florida: Sugar cane.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Miami.

Distribution elsewhere: Bahama Islands, British Honduras, British West Indies, Cuba, Grand Cayman, Isle of Pines, Panama, West Indies.

Remarks: This scale may well be considered a serious pest of sugar cane.

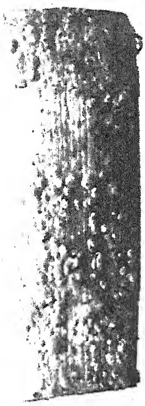


Fig. 69.—*Targionia sacchari* (Ckll.) (Sugar-cane Scale) Slightly enlarged.

B. The Soft Scales

1. *Ceroplastes ceriferus* (Anderson) (Japanese Wax Scale) (Fig. 70)

Test or covering of female: Circular, waxy, thick, very convex, having surface more or less roughened. Diameter varying from 3-8 mm. Color white or creamy-white.

Adult female: Oval, very convex and varying from 2-6 mm. in diameter. Color dark brown or purplish brown. There is a long, funnel-shaped process which extends posteriorly through and even with the outer surface of the test. As with all wax scales, the female fits under the concave surface of the test.

Test or covering of male: "Opaque glassy-white, with a broad central, and three lateral carinae; the central ones meeting form a complete loop. Long 2-2½ mm." (after Newstead).

Plants found infested in Florida: Citrus, gumbo limbo, hog plum *(Spondias purpurea)*, pigeon plum *(Cocolobis laurifolia)*, sapodilla, *Trema floridana* and wild persimmon.

Additional plants found infested elsewhere: *Antigonon* sp., *Camellia* sp., *Ficus* sp., *Gardenia* sp., hibiscus, mango, *Melaleuca* sp., mulberry, orange, *Poulzolzia walkeriana*, tea, etc.

Distribution in Florida: Dundee, Key West, Miami, Oneco, Rock Harbor, Sebring, Tropic, West Palm Beach and Winter Haven.

Distribution elsewhere: California; Antigua, Australia, Ceylon, Chili, Formosa, Hawaiian Islands, India, Jamaica, Japan, Mexico, Porto Rico, San Thome, South America, Uganda Protectorate.

Remarks: This scale is not a serious pest.

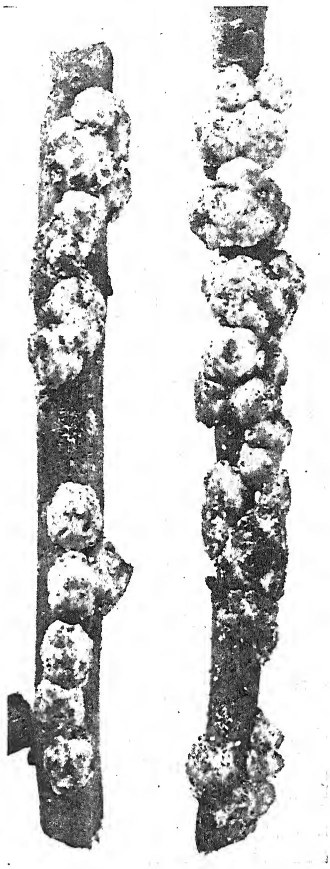


Fig. 70. — *Ceroplastes ceriferus* (And.) (Japanese Wax Scale) Enlarged twice. (After Wilson)

2. *Ceroplastes cirripediformis* Comst. (Barnacle Scale) (Fig. 71)

Test or covering of female: Rather flatly hemispherical, waxy. About 5 mm. long, 4 mm. wide and 4 mm. high. Color dirty white, mottled with various shades of gray or light brown. There is one top and six side plates, each of which contains a central nucleus or spot, except the anal plate which contains two spots.

Adult female: Fits closely into the under surface of the test, therefore, has somewhat smaller dimensions. Color dark or reddish brown. There is a strong, spine-like process which extends through the waxy covering at the anal end of the body.

Test or covering of male: Not observed.

Plants found infested in Florida: Australian pine, Brazilian pepper tree, *Citrus* sp., flame-flower, guava, jasmine, Jerusalem thorn, pear, poinsettia, tea, tecoma vine and wild persimmon.

Additional plants found infested elsewhere: *Eupatorium* sp., lignum-vitae, myrtle, quince and *Solanum* sp.

Distribution in Florida: General.

Distribution elsewhere: California, Louisiana, Mississippi; British Guiana, Cuba, Lower California, Mexico, Porto Rico, West Indies.

Remarks: This scale never becomes very abundant in Florida.

3. *Ceroplastes floridensis* Comst. (Florida Wax Scale) (Fig. 72)

Test or covering of female: Approximately circular, very convex, thick, waxy and varying from 2-3 mm. in diameter. Color usually dirty white, occasionally softly tinted with pinks in certain areas. There is often a blackish spot arising from the top of the test, also several on the sides just above the margin.

Adult female: Fits closely into the under surface of the test or covering, therefore, somewhat smaller in diameter. Color dark reddish or purplish brown. The anal projection is very short and blunt.

Test of male: Not observed.

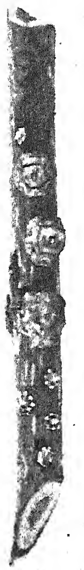


Fig. 71.—*Ceroplastes cirripediformis* Comst. (Barnacle Scale) Slightly enlarged. (After Wilson)

Plants found infested in Florida: Apple, avocado, bays, blueberry, boxwood, *Bucida buceras*, Cape jasmine, *Carissa* sp., cherry laurel, cinnamon, *Citrus* spp., croton, *Cryptostegia* sp., *Euonymus* sp., fern, *Ficus* spp., guava, *Ilex* spp., India hawthorn, *Ixora* sp., loquat, mango, magnolia, maple, marlberry, *Muehlenbeckia* sp., mulberry, myrtle (crape), oleander, peach, pear, pine, *Pittosporum floribundum*, plum, poinsettia, prickly ash, sapodilla, sea grape, Surinam cherry, tea and *Triplasis* sp.

Additional plants found infested elsewhere: *Andromeda* sp., *Anona reticulata* (custard apple), *Anthurium* sp., lignum-vitae and pomegranate.

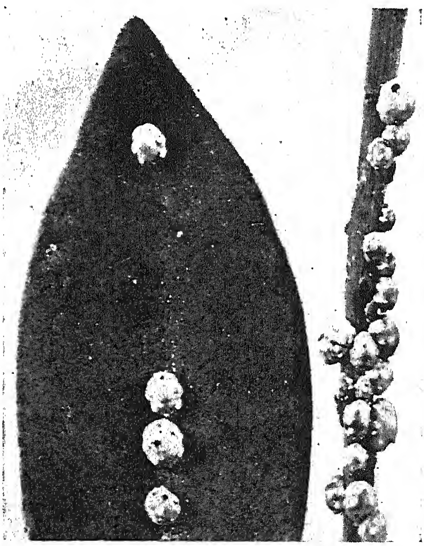


Fig. 72.—*Ceroplastes floridensis* Comst. (Florida Wax Scale) Enlarged twice. (After Wilson)

Distribution in Florida: General.

Distribution elsewhere: California, Louisiana, Mississippi; Assam, Australia, Bermuda, Brazil, British Guiana, Ceylon, Cuba, Darjeeling, Formosa, Hawaiian Islands, India, Japan, Mexico, Porto Rico, Spanish Honduras, Virgin Islands, West Indies.

Remarks: This scale is not generally considered a serious pest.

4. *Coccus acuminatus* (Sign.) (Acuminate Scale) (Fig. 73)

Adult female: Resembling an irregular triangle, front angle very bluntly pointed while the other two are more or less rounded. Length varying from 2-3.25 mm., breadth from 1.5-2.5 mm. Color pale green or yellowish green. Anal lobes located at about one-third the distance between the hind margin and front angle. The scale is thin and flat.

Male: Not observed.

Plants found infested in Florida: Banana, Brazilian pepper tree, Cape jasmine, mango, persimmon, rose apple and sapodilla.

Additional plants found infested elsewhere: Guava, jasmine, orchids, spice and *Tabernaemontana* sp.

Distribution in Florida: Coconut Grove, Cutler, Florida City, Ft. Lauderdale, Key Biscayne, Little River, Miami, Miami Beach and West Palm Beach.

Distribution elsewhere: Georgia, Massachusetts, New York; Antigua, Bahama Islands, Barbados, Ceylon, China, Cuba, England, France, Fiji, Grenada, Hawaiian Islands, India, Jamaica, Mauritius, Mexico, New Zealand, Porto Rico.

Remarks: This scale is a very serious pest in Florida, especially on mango. This species was wrongly determined as *C. mangiferae* (Green) in C. E. Wilson's paper.

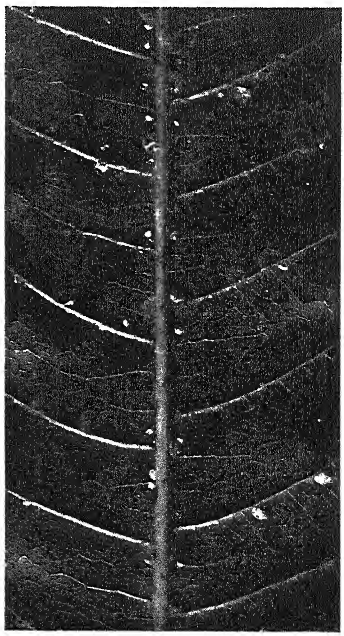


Fig. 73.—*Coccus acuminatus* (Sign.) (Acuminate Scale) Natural size.

5. *Coccus elongatus* Sign. (Long Soft Scale)
(Fig. 74)

Adult female: Elongate-elliptical, moderately convex, smooth and varying from 5-8 mm. long by 1.75-2.5 mm. wide. Color yellowish or brownish gray. Portions of upper surface have darkened or mottled areas. Under surface hollowed for the protection of the very young scales.

Fig. 74.—*Coccus elongatus* Sign. (Long Soft Scale) Slightly enlarged.

Male: Not observed.

Plants found infested in Florida: Acalypha, Australian silk oak, croton, gopher plum *(Chrysobalanus icaco)*, mountain ebony, *Pithecolobium* sp. and poinsettia.

Additional plants found infested elsewhere: *Acacia* spp., *Albizzia* sp., *Anona* sp., *Averrhoa carembola,* bamboo, *Cassia fistula, Citrus* spp., *Euphorbia* sp., ferns, *Ficus pandurata, Latania borbonica,* loranthus, *Monestera deliciosa, Myrica fragifera, Psidium* sp., *Spathophyllum blandum, Tabernaemontana* sp., etc.

Distribution in Florida: Clearwater, Coconut Grove, Ft. Myers, Jacksonville, Key West, Miami, Oneco, Orlando, Palatka, St. Petersburg and West Palm Beach.

Distribution elsewhere: Indiana, Massachusetts, Michigan; France, Italy, Philippine Islands, South Africa.

Remarks: This scale may well be considered of economic importance.

6. *Coccus hesperidum* (Linn.) (Soft Brown Scale)
(Fig. 75)

Adult female: Oval, comparatively flat, except in parasitized specimens which are quite convex. Length varying from 2.5-4 mm., width from 1.5-2.5 mm. Color yellowish green or greenish brown. The underside of the female is quite concave thereby affording protection for the newly born scales.

Male: Not observed.

Plants found infested in Florida: *Acalypha* sp., Apollo laurel, avocado, banana, bays, Brazilian pepper tree, *Bursera copal*, caladium, *Citrus* spp., cotton, croton, *Dombeya* sp., *Elaeagnus* sp., ferns, *Ficus* sp., frangipanni, *Furcraea* sp., guava, *Hibiscus* sp., Italian pine, ivy, Jasmine, Jerusalem oak, Jupiter tree, loquat, *Microcitrus* sp., mountain ebony, oleander, orchid, palms, papaya. pear, persimmon, *Philibertia clausa*, *Pittosporum* sp., *Pothos* sp., *Pseuderanthemum* sp., red alder, rose, sea grape, willow and Wisteria.

Additional plants found infested elsewhere: Clematis, holly, japonica, mimosa, mulberry, myrtle, Norfolk Island pine, poinsettia, etc.

Distribution in Florida: General.

Distribution elsewhere: United States; Algeria, Australia, Austria, British Guiana, Canada, Caucasia, Chili, Cuba, Dutch East Indies, Ecuador, England, Europe, France, Haiti, Hawaiian Islands, Italy, Japan, Mauritius, Mexico, Morocco, New Zealand, Norway, Philippines, Portugal, Sandwich Islands, Seychelles, Sicily, South Africa, South France, West Indies.

Remarks: This scale occurs very abundantly but is usually controlled by its natural enemies, principally a minute wasp-like parasite.

Fig. 75.—*Coccus hesperidum* (Linn.) (Soft Brown Scale) Natural size. (From Report of the Entomologist, in Annual Report United States Commissioner of Agriculture, 1880. Fig. 2, Plate VIII. After Comstock.)

7. *Coccus mangiferae* (Green) (Mango Shield Scale)

Adult female: Somewhat triangular in shape, irregular, bluntly pointed in front, broadly rounded behind, thin, flat and varying from 2.5-4 mm. in length by 2.25-3.5 mm. in width. Color yellowish green. This scale is very similar to *C. acuminatus* (Sign.) as given above.

Male: Not observed.

Plants found infested in Florida: Mango.

Additional plants found infested elsewhere: *Allamanda* sp., breadfruit, cinnamon, *Ixora* sp., *Jambosa* sp., jasmine, nutmeg, orchid and sapodilla.

Distribution in Florida: Tampa.

Distribution elsewhere: California; Antigua, Barbados, British Guiana, Ceylon, Cuba, Grenada, Jamaica, Mauritius, Panama Canal Zone, St. Lucia, Seychelles, Trinidad, Virgin Islands.

Remarks: This scale may become a serious pest.

8. *Coccus pseudohesperidum* (Ckll.)

Adult female: Elongate-elliptical, moderately convex. From 6-9 mm. in length. Color varying from light to dark brown. The surface is slightly roughened.

Male: Not observed.

Plants found infested in Florida: Orchid.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Oneco.

Distribution elsewhere: New York; Great Britain, Canada.

Remarks: Little is known in regard to its economic importance.

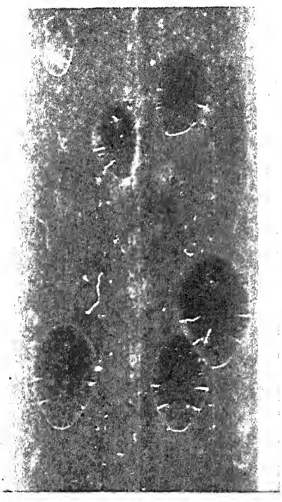


Fig. 76.—*Eucalymnatus tessellatus* (Sign.) (Tessellated, or Palm Scale) Greatly enlarged.

9. *Eucalymnatus tessellatus* (Sign.)
(Tessellated or Palm Scale)
(Fig. 76)

Adult female: Oval, sometimes with one side nearly straight, broader behind, flat and varying from 2.5-4 mm. long by 2-3 mm. wide. Color dark brown or reddish brown. The surface has a distinctly tessellated or net-like appearance, so much so that it appears as though the plates were nicely fitted and riveted together.

Male: Not observed.

Plants found infested in Florida: Banana, bay, bottle brush *(Callistemon* sp.), cinnamon, *Dracaena* sp., English ivy, *Ficus* sp., guava, holly, jasmine, lancewood, mango, oleander, palms, rose apple and *Tabernaemontana* sp.

Additional plants found infested elsewhere: Laurel *(Laurus nobilis)*, soap berry *(Sapindus saponaria)* and star apple.

Distribution in Florida: Clearwater, Coconut Grove, Cutler, Florida City, Ft. Myers, Gainesville, Jacksonville, Lake City, Little River, Miami, Oneco, Palm Beach, Pensacola, Redland, St. Petersburg, Tampa and West Palm Beach.

Distribution elsewhere: California, Colorado, Indiana, Illinois, New York; Australia, Bahamas, Bermuda, Ceylon, England, France, Hawaiian Islands, Java, Mauritius, Porto Rico, Seychelles.

Remarks: This scale becomes quite abundant, especially on palms.

10. *Inglisia vitrea* Ckll.

(Fig. 77)

Test or covering of female: Circular or ovate, irregular, moderately convex, sometimes indented from margin, surface roughened. Varies from 2.5-4 mm. in diameter. Color glassy white.

Adult female: The adult female fits into the under side of the test or covering, therefore, is smaller than the dimensions given above. Color polished brown or reddish brown. Anal lobes about one-third or one-half the distance from the front and rear portions.

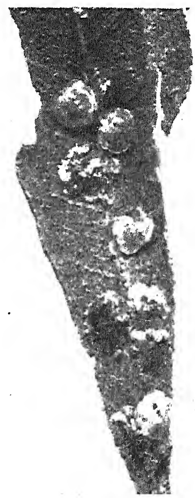


Fig. 77.—*Inglisia vitrea* Ckll. Greatly enlarged.

Test of male: Not observed.

Plants found infested in Florida: Dahoon *(Ilex cassine)* and wax myrtle *(Morella cerifera)*.

Additional plants found infested elsewhere: *Acacia* sp.

Distribution in Florida: Lake Wales, Sebring and Winter Park.

Distribution elsewhere: Panama Canal Zone, Trinidad.

Remarks: This scale is of little economic importance.

11. *Lecanium corni* (Bouche) (European Fruit Lecanium)

(Fig. 78)

Adult female: "Largest diameter ranging from 3.5-6 mm.; shape circular to oval, strongly convex; old female dark brown, the margins showing a heavier chitinization than the dorsum;

dorsum nearly smooth, but the surface strongly wrinkled near the margins; the wrinkles mostly parallel to the body margin; antennae fairly well developed, normally 7-segmented; legs fairly well developed; derm pores usually of two sizes, some apparently double or multiple, arranged in more or less definite but very irregular rows radiating from center to margin, this less pronounced in some specimens; also with a closely set elongate group of pores running cephalad from the anal plates; marginal spines rather short and stout, spiracular spines rather slender, the median not twice as long as the outer ones; anal plates broad, each plate a little less than twice as long as broad, caudo-lateral margin typically slightly longer than cephalo-lateral; with four fringe setae arranged in two pairs, with two subapical, and four apical setae on each plate; anal ring with eight hairs, two smaller than the others."

Fig. 78. — *Lecanium corni* (Bouche) (European Fruit Lecanium) Enlarged twice.

Male: Not observed.

Plants found infested in Florida: Japanese persimmon.

Aditional plants found infested elsewhere: Basswood *(Tilia americana)*, *Cornus sanguinea*, *Corylus* sp., elm *(Ulmus americana)*, euonymus, hackberry *(Celtis occidentalis)*, maple, pin oak *(Quercus palustris)*, plum, *Pyrus* sp., *Ribes rubrum*, sweet gum *(Liquidambar styraciflua)*, walnut, etc.

Distribution in Florida: Gainesville and Irvine.

Distribution elsewhere: California, Michigan, United States; Austria, Europe, France, Germany, Holland, Norway, Sweden, Switzerland.

Remarks: This scale occurs rather abundantly on its Florida host but seems to be controlled by its natural enemies. The above description is taken from Dietz and Morrison in The Coccidae or Scale Insects of Indiana (April, 1916) page 256.

12. *Lecanium nigrofasciatum* (Pergande) (Terrapin Scale) (Fig. 79)

Adult female: "The adult female is from 3 mm. to 4 mm. long, by 2.6 mm. in diameter, and about 2 mm. high. It is slightly

broadest posteriorly, hemispherical, highly polished, and if not rubbed is seen to be covered with a very delicate, transparent, and glossy or waxy excretion. There are apparently twelve more or less distinct and radiating ridges each side, which are most noticeable around the margin of the body and starting at some distance from the disk of the scale, those of the thoracic segments being generally more highly developed. The disk or medio-dorsal stripe is smooth or but faintly rugose. The general color is of a lighter or darker red, with a broader or narrower blackish subdorsal band surrounding the disk composed of confluent spots, and a marginal row of elongated squarish spots or bands between the ridges of the same dark color, which frequently extend to the subdorsal band, which give to them a peculiarly pretty appearance. Frequently they may be entirely black, with the exception of the median stripe, or they may be entirely red, with but faint traces of darker shadings or markings, while in dry specimens all the markings disappear entirely."

Fig. 79.—*Lecanium nigrofasciatum* (Perg.) (Terrapin Scale) Enlarged three times.

Male: Not observed.

Plants found infested in Florida: Bays, blueberry, dahoon *(Ilex cassine)*, oak and sweet gum.

Additional plants found infested elsewhere: Apple, birch, linden, maple, olive, peach, plums (wild and cultivated), *Vaccinium* spp., etc.

Distribution in Florida: Cocoa, Gainesville, Lake Hamilton, Lake Wales, Macclenny, Ponce Park, Sebring, Winter Haven and Winter Park.

Distribution elsewhere: Delaware, District of Columbia, Illinois, Indiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New York, New Jersey, Ohio, Pennsylvania, Tennessee; Canada, etc.

Remarks: This scale is not of economic importance in Florida. The above description was copied from Theo. Pergande, Bureau Entomology, U. S. D. A., Bulletin 18, n. s., page 29 (1898).

13. *Lecanium persicae* (Fab.) (Peach Lecanium)

Adult female: Oval, moderately convex and varying from 3.25-7 mm. long by 2-4 mm. wide. Color light or dark chestnut-brown. Sometimes sparsely sprinkled with whitish wax-like particles.

Male: Not observed.

Plants found infested in Florida: Plum.

Additional plants found infested elsewhere: English ivy, ginko, gooseberry, grape, *Grindelia hirsuta,* holly *(Ilex opaca),* Japanese quince, *Magnolia glauca,* mulberry, nectarine, oleaster *(Elaeagnus angustifolia),* peach, plum and rose.

Distribution in Florida: Shady Grove.

Distribution elsewhere: United States, Australia, Europe and Nova Scotia.

Remarks: In Europe, occasionally plays the role of a serious pest.

14. *Lecanium quercifex* Fitch (Oak Lecanium)
(Fig. 80)

Adult female: "The shape is elliptical, tapering slightly at both ends. The dorsal cuticle is dark brown, with small clear areas each of which contains a very small dot. Length, 4 mm.; width, 3 mm. The antenna has seven segments, with the third and fourth subequal. The anal plate is slightly more than one-half as broad as long, with the lateral margins subequal, and the lateral extremity and the apex are rounded. There are two subapical and four apical setae on each plate, with the latter clustered at the apex and the anterior seta one-ninth of the length of the plate from the apex. There are four fringe setae subequal in length in groups of two. On the hypopigium, there are short

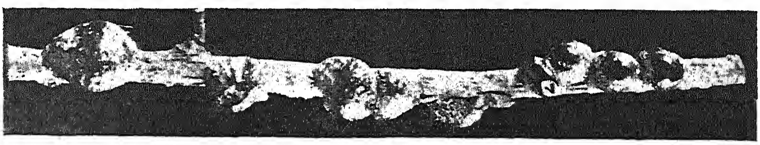


Fig. 80.—*Lecanium quercifex* Fitch. (Oak Lecanium) Enlarged twice. (After Wilson)

transverse rows of short striations. All of the spiracular setae are long and conical with the first one of each group slightly over one-half as long as the middle one. Most of the marginal setae are short and blunt, with the longest less than one-half as long as the first spiracular seta. It is oviparous."

Male: Not observed.

Plants found infested in Florida: Live oak *(Quercus virginiana)* and water oak *(Quercus nigra)*.

Additional plants found infested elsewhere: White oak and willow oak.

Distribution in Florida: Gainesville, Marianna and Tampa.

Distribution elsewhere: Indiana, Massachusetts, New York, Ohio; Canada.

Remarks: This scale is not apparently an important one. The above description is taken from William C. Thro in Bulletin 209, Cornell University Experiment Station, page 213 (1903).

15. *Neolecanium cornuparvum* (Thro) (Magnolia Soft Scale) (Fig. 81)

Adult female: "The shape is elliptical and quite convex. The dorsal cuticle is shiny brown with a tinge of grey, and it is densely alveolate, with large glands. Length, 8-10 mm.; width, 5-8 mm. The spiracular grooves leave white dust when the insect is removed from the bark. The antenna is short and stout with six indistinct segments, and is of the vestigial type. The anal plate is two hundred and forty-eight microns long (the anal plate of *hesperidum* is two hundred microns long) and is two-thirds as broad as long, with the cephalo-lateral margin longer than the caudo-lateral, and both the lateral extremity and the apex rounded. There are five subapical and four apical setae. There are two large fringe setae, one on each ventral thickening and at least sixteen hypopigial setae. There are three short, stout spiracular setae, subequal in length, and about one-half as broad as long, with the medium seta notched at the apex. The marginal setae are short and conical. The legs are short and stubby with a small claw. It is viviparous, with the young scales, black. The dried young have a medium carina and many transverse carinae."

Fig. 81.—*Neolecanium cornuparvum* (Thro) (Magnolia Soft Scale)) Enlarged twice. (After Wilson)

Male: Not known.

Plants found infested in Florida: *Magnolia grandiflora*.

Additional plants found infested elsewhere: Magnolias.

Distribution in Florida: Leesburg.

Distribution elsewhere: Indiana, New York, Ohio, Northeastern States, Michigan.

Remarks: This scale is at present of no economic importance. The above description is taken from the original by William C. Thro in Bulletin 209, Cornell University Experiment Station, page 216 (1903).

16. *Pseudophilippia quaintancii* Ckll. (Cottony Pine Scale) (Fig. 82)

Adult female: Oval or hemispherical and varying from 2-2.5 mm. in diameter. Color yellowish or light brown. These scales are covered with a profusion of fluffy, snow-white, cottony or fleecy-like secretion. Situated, usually, at the base of the needles (leaves).

Fig. 82. — *Pseudophilippia quaintancii* Ckll. (Cottony Pine Scale) Enlarged three times.

Male: Not observed.

Plants found infested in Florida: Pine.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Jacksonville.

Distribution elsewhere: Virginia.

Remarks: Not considered of economic importance.

17. *Pulvinaria psidii* Mask. (Green Shield Scale) (Fig. 83)

Adult female: Oval, smooth and moderately convex at first, but with deposition of eggs the female gradually shrivels and the surface forms into ridges and valleys. Length varying from 2-4 mm. Color green. Occasionally covered with a whitish, powdery secretion.

Female ovisac, or egg-sac: Cottony; projecting mostly to the rear at first but eventually more or less surrounding the adult female and elevating hinder parts so that she becomes inclined. Length varying from 4-7 mm. Color white.

Test of male: Not observed.

Plants found infested in Florida: Akee tree, *Antidesma venosum,* avocado, Australian silk oak, bay, *Carissa* spp., chalice vine, citrus, *Clerodendron* sp., croton, *Cycas* sp., cypress vine, fern, *Ficus* spp., fiddlewood, frangipanni, guava, *Hibiscus* sp., *Ixora* sp., jasmine, mammea apple, mango, mastic, *Nephelium longana,* palms, persimmon, pigeon plum, rose apple, sapodilla, scarlet bush *(Hamelia* sp.), sea grape, *Solanum* sp., star apple, *Tetrazygia* sp., tropical almond, wax myrtle and yellow elder.

Additional plants found infested elsewhere: *Anthurium* sp., *Cardamomum* sp., cinchona, coffee, *Durantia* sp., *Eugenia* sp., *Garcinia* sp., plum, tea, *Tecoma* sp., wild catnip, etc.

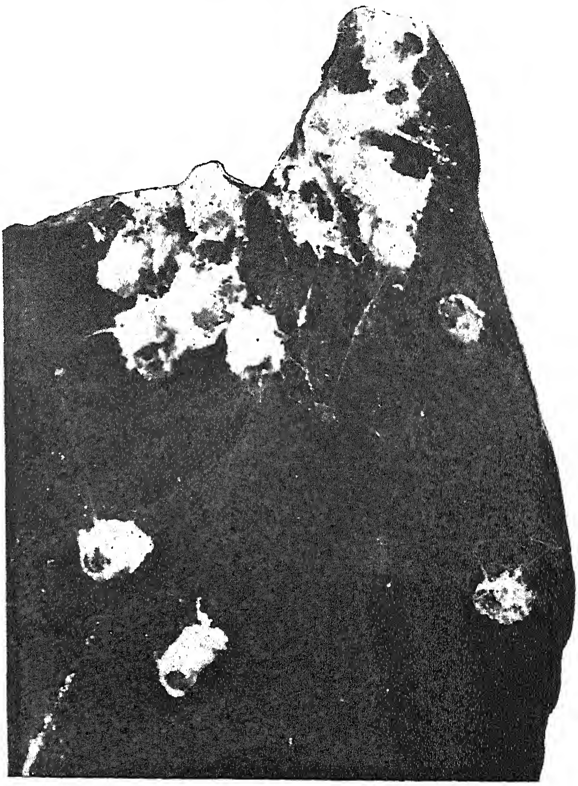


Fig. 83.—*Pulvinaria psidii* Mask. (Green Shield Scale) Enlarged twice. (After Wilson)

Distribution in Florida: Arch Creek, Boynton, Bradentown, Buena Vista, Canal Point, Cocoa, Coconut Grove, Colohatchee, Cutler, Dania, Ft. Lauderdale, Ft. Myers, Ft. Pierce, Homestead, Key Biscayne, Key West, Lakeland, Little River, Miami, Oneco, Pahokee, Palm Beach, Pompano, Redland, Riveria, St. Petersburg, Sebring, Tampa, Waverly and West Palm Beach.

Distribution elsewhere: California, Pennsylvania; Algeria, Ceylon, China, Cuba, East Africa, Formosa, Hawaiian Islands, India, Japan, New Zealand, Philippine Islands, Sumatra, Uganda Protectorate, Virgin Islands, West Indies.

Remarks: This scale is a serious pest on certain ornamental plants and guava.

18. *Pulvinaria pyriformis* Ckll. (Pyriform Scale) (Fig. 84)

Adult female: Broadly triangular or pear-shaped, flat; the front angle being moderately acute while the hind angles are broadly rounded. Length varying from 2.5-3.5 mm., width from 2.5-3.25 mm. Color varying from light greenish brown to brown. The color of the female just before maturity is yellowish green with purplish radiating lineal areas on the upper surface.

Female ovisac or egg-sac: Appearing like a fringe around the margin of the adult female. Color white.

Test of male: Not observed.

Plants found infested in Florida: *Acalypha* sp., avocado, bay, bottle brush, camphor, cinnamon, croton, English ivy, *Eugenia* sp., grapefruit, guava, honeysuckle, *Ixora* sp., jasmine, loquat, mango, mountain ebony, *Nephelium longana*, papaya, *Rhynchospermum* sp., rose apple, sapodilla, Spanish laurel and *Syzygium* sp.

Additional plants found infested elsewhere: *Caprifolia* sp., *Cordia* sp., palm, etc.

Distribution in Florida: General.

Distribution elsewhere: Bermuda, British Guiana, Cuba, Grenada, Jamaica, Madeira, Panama Canal Zone, South Africa, Spanish Honduras, Tobago, Trinidad.

Remarks: This scale is of economic importance, especially on avocado and guava.

19. *Pulvinaria urbicola* Ckll.

Adult female: Oval, slightly convex and varying from 2.5-3 mm. in length by 1.5-1.75 mm. in width. Color light or dark yellowish green or grayish green. With the deposition of eggs the female becomes more or less transversely ridged.

Female ovisac or egg-sac: Elongate-oblong, straight or curved, felty, sides parallel, feebly ribbed lengthwise. Varies from 4-9 mm. in length. Approximately 2 mm. in width. The ovisac usually filled with many minute yellowish eggs.

Test of male: Not observed.

Plants found infested in Florida: Angel's trumpet, citrus, English ivy, guava and pepper.

Additional plants found infested elsewhere: Capsicum.

Distribution in Florida: Crescent City, Ft. Pierce, New Port Richey and Palatka.

Distribution elsewhere: Barbados, Jamaica and Trinidad.

Remarks: This scale does not occur abundantly in Florida. A comparison of a topotype slide with Florida specimens agrees quite well in most details.

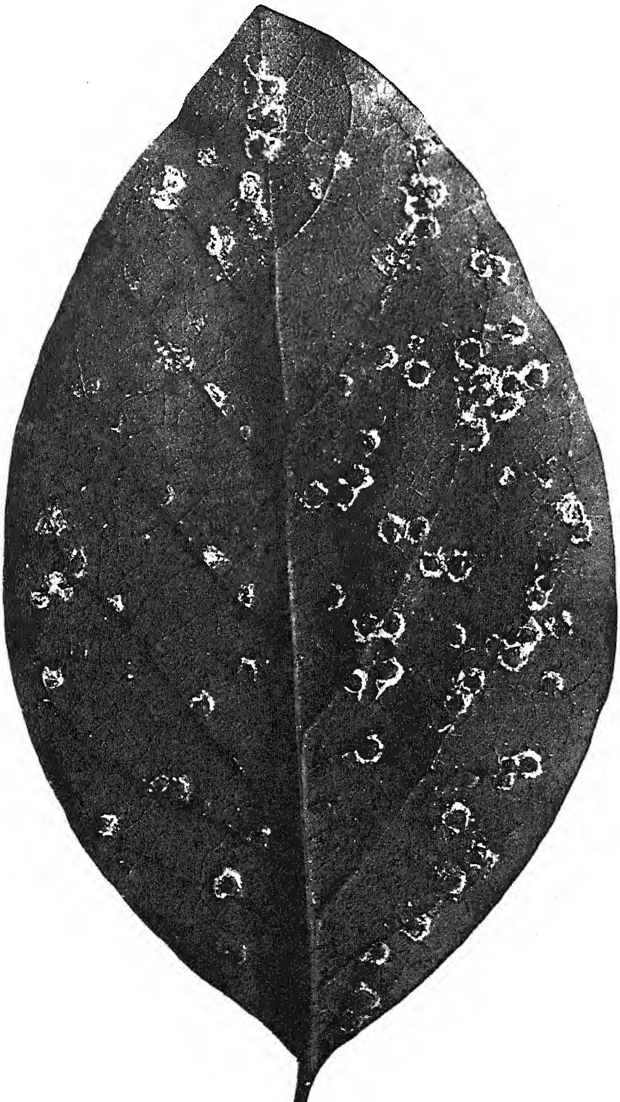


Fig. 84.—*Pulvinaria pyriformis* Ckll. (Pyriform Scale) Slightly enlarged. (After Wilson)

20. *Pulvinaria vitis* (Linn.) (Cottony Maple Scale)
(Fig. 85)

Adult female: Oval or somewhat heart-shaped, convex, with a more or less distinct longitudinal median ridge, surface somewhat wrinkled crosswise. Length varying from 4-6 mm., width from 3-4.5 mm. Color a variable light or dark brown.

Female ovisac or egg-sac: Broadly rounded from the hinder and under portion of the adult female. Cottony. Length variable. Color white. When the sac is completed the female is sometimes elevated at an angle of nearly 45° with the surface of the plant.

Test of male: Not observed.

Plants found infested in Florida: Boston ivy, cherry, grape, hickory, holly, live oak, pecan, pennyroyal, Virginia creeper and wax myrtle.

Additional plants found infested elsewhere: Alder, apple, *Aesculus flava, Aralia japonica,* beech, blackberry, boxwood, buckeye, citrus, currant, elm, hackberry, hawthorn, lilac, linden, locust, maples, mountain ash, mulberry, oaks, osage orange, peach, pear, plum, poplar, quince, rose, sarsaparilla, spindle tree, spiraea, sumac, sycamore, *Viburnum dentatum,* willow and woodbine.

Fig. 85. — *Pulvinaria vitis* (Linn.) (Cottony Maple Scale) Natural size. (After Wilson)

Distribution in Florida: Brooksville, Citrus Park, City Point, Cortez, Gainesville, Glen St. Mary, Hawthorne, Hudson, Lake City, Macclenny, Monticello, Oneco, Palatka, Palma Sola, Sebring, Tampa, Titusville, West Palm Beach and Winter Haven.

Distribution elsewhere: United States, Europe, England, France, Germany, Italy, Norway, Portugal, Russia.

Remarks: This scale is not of economic importance in Florida.

21. *Saissetia hemisphaerica* (Targ.) (Hemispherical Scale)
(Fig. 86)

Adult female: More or less hemispherical, oval or elongate-oval, very convex, surface smooth and glossy. Diameter varying from 1.5-3.5 mm. by about 1.75 mm. in height. Color, variable, from a light to a dark brown. The upper surface with many minute, circular areas readily seen under a hand lens.

Fig. 86. — *Saissetia hemisphaerica* (Targ.) (Hemispherical Scale) (After Wilson) Slightly enlarged.

Test of male: Not observed.

Plants found infested in Florida: *Allamanda* sp., almond, arborvitae, *Ardisia* sp., avocado, bachelor's button, *Bougainvillea* sp., Brazilian pepper tree, *Carissa* sp., *Citrus* spp., *Claucena lansium,* comptie, coral plant, croton, *Cryptostegia grandiflora,,* custard apple, *Cycas* sp., *Cyrtopodium punctatum,* elder *(Tecoma* sp.), *Eranthemum* sp., ferns, fire bush, heavenly bamboo, *Helianthus* sp., *Jacaranda* spp., jasmine *(Cestrum* sp.), *Lagerstroemia* sp., *Mammea* sp., mesquite *(Prosopis juliflora),* oleander, palms, *Philibertia clausa, Plumeria* sp., *Rheedia* spp., rosa de Montana, sapodilla, *Solanum* sp., soursop, *Stephanotis* sp., sugar apple, *Tabernaemontana* sp., tea plant mate, wild coffee.

Additional plants found infested elsewhere: *Aloe* spp., *Bignonia* sp., *Camellia* sp., *Chrysanthemum* sp., citron, coffee, guava, mountain holly, orchids, peach, rose and *Zamia* sp.

Distribution in Florida: General.

Distribution elsewhere: United States, Argentine, Australia, Bahamas, Brazil, British Guiana, Canada, Ceylon, Cuba, East Africa, Europe, England, Formosa, Galapagos Islands, Grand Cayman, Hawaiian Islands, Holland, India, Jamaica, Mauritius, Mexico, New Zealand, Norway, Panama Canal Zone, Philippine Islands, Porto Rico, Portugal, San Thome, Seychelles, South Africa, Virgin Islands, West Indies. Probably cosmopolitan.

Remarks: This scale occurs abundantly on cycads and palms.

22. *Saissetia nigra* (Nietn.)
(Fig. 87)

Adult female: Elongate-oval, somewhat narrowed in front, slightly curved lengthwise, moderately convex, or humpbacked at middle. Length varying from 3.5-4 mm. Color varying from brown to brownish black. Surface slightly pitted or grooved transversely or across the scale. There are small, light-colored spots over the entire surface.

Test of male: Not observed.

Plants found infested in Florida: Bay, hibiscus, mango, and papaya.

Additional plants found infested elsewhere: Asparagus, bamboo, begonia, Ceara rubber, cotton, *Cobaea* sp., coffee tree, croton, *Psidium* sp. and *Terminalia catappa.*

Distribution in Florida: Bradentown, Cocoa, Coconut Grove, Ellenton, Gomez, Lake Wales, Oneco, Orlando, St. Petersburg, Sanford and Sebring.

Distribution elsewhere: Antigua, Australia, Barbados, Bihar, British Guiana, Ceylon, Demerara, East Africa, England, Formosa, Grenada, Hawaiian Islands, India, Lower California, Mauritius, New Zealand, Panama Canal Zone, Philippine Islands, Porto Rico, San Thome, Seychelles, Siam, South Africa, Sumatra, Tobago, Trinidad, Virgin Islands, West Indies. (Tropicopolitan),

Remarks: This scale is a serious pest on hibiscus.

Fig. 87. — *Saissetia nigra* (Nietn.) Slightly enlarged.

23. *Saissetia oleae* (Bern.) (Black Scale) (Fig. 88)

Adult female: Nearly hemispherical, highly rounded and hard shelled. Varying from 2-4.5 mm. in length, by 1.5-3 mm. in width and 1.5-2.5 mm. in height. Color very dark brown, black or purplish black. The upper surface has one short longitudinal and two transverse elevations or ridges which form a rather distinct capital H. The upper surface is, also, more often dotted with minute specks of white, waxy material.

Test of male: Not observed.

Plants found infested in Florida: *Assonia* sp., Australian silk oak, avocado, Brazilian pepper tree, cassava, Chinaberry, citrus, *Cordia sebertina*, cotton, crepe myrtle, *Cryptostegia grandiflora*, *Cycas* sp., cypress vine, *Eugenia* sp., ferns, *Ficus* spp., fig, *Gardenia* sp., *Glycosmis pentaphylla*, grape, guava, hibiscus, *Ixora* sp., *Jacaranda* sp., *Lagerstroemia* sp., mango, mate, mountain ebony, oleander, palm, persimmon, pigeon pea, *Pittosporum* sp., poinsettia, poison oak, pomegranate, prickly ash, red elder, *Rheedia* sp., rosa de Montana, royal poinciana, sapodilla, sea

grape, sour sop, Spanish needle, *Symphoricarpos* sp., tea plant, tropical almond, yellow elder.

Additional plants found infested elsewhere: *Anona* sp., *Antidesma* sp., apple, apricot, aster, *Camellia* sp., canipe, chrysanthemum, devil's pumpkin, *Hoffmania* sp., holly, Irish juniper, laurel, locust, magnolia, *Mammea* sp., mountain ash, nightshade, olive, orchids, Oregon ash, pear, phlox, plum, poplar, privet, prune, rose, *Stephanotis* sp., sumac, sycamore, watermelon, etc.

Distribution in Florida: General.

Distribution elsewhere: California, Illinois, Indiana, Louisiana, Ohio, Pennsylvania, South Carolina, Texas; Algeria, Australia, Bahamas, Brazil, British Guiana, Canary Islands, Ceylon, Chile, China, Cuba, England, Europe, France, Hawaiian Islands, Honduras, India, Isle of Pines, Italy, Jamaica, Japan, Lower California, Mauritius, Mexico, New Zealand, Panama Canal Zone, Philippine Islands, Porto Rico, Portugal, Sicily, South Africa, Spain, Uganda Protectorate, Victoria, Virgin Islands, West Indies, etc. (Tropicopolitan.)

Remarks: Of economic importance in California and some countries but successfully controlled in Florida by its natural enemies.

Fig. 88.—*Saissetia oleae* (Bern.) (Black Scale) Slightly enlarged. (After Wilson)

24. *Toumeyella liriodendri* (Gmel.) (Liriodendron Scale) (Figs. 89-90)

Adult female: Oval or somewhat oblong, looking much like a cattle tick, very convex, wrinkled and varying from 4-7.5 mm. in length by 1.5-2.5 mm. in height. Color variable, from a mottled, grayish green, to brown or black.

Fig. 89.—*Toumeyella liriodendri* (Gmel.) (Liriodendron Scale) Females on twig. Enlarged twice. (After Wilson)

Test of male: Oval, flat, thin, glassy, somewhat sculptured and from 1.5-2 mm. long.

Plants found infested in Florida: Bays, banana shrub, button bush, cape jasmine, loblolly bay *(Gordonia lasianthus)*, magnolias and walnut.

Additional plants found infested elsewhere: Tulip-tree *(Liriodendron tulipifera)*.

Distribution in Florida: General.

Distribution elsewhere: Northeastern United States, east of Mississippi River and south of the Mason-Dixon line; Europe.

Remarks: This scale occasionally becomes a serious pest on banana shrub and magnolia.

25. *Toumeyella parvicornis* (Ckll.)

Adult female: "Female scale about 5 mm. long, 4 broad and 3 high, of the ordinary Lecanium form, rather shiny; with irregular longitudinal series of conspicuous pits, one row on each side subdorsally, and two irregular and subconfluent rows laterally. Color of scale ochreous often with a pinkish tinge, with irregular black spots accompanying the rows of pits. Sometimes there are suffused blackish longitudinal bands in place of the spots. Under surface of female dull pink.

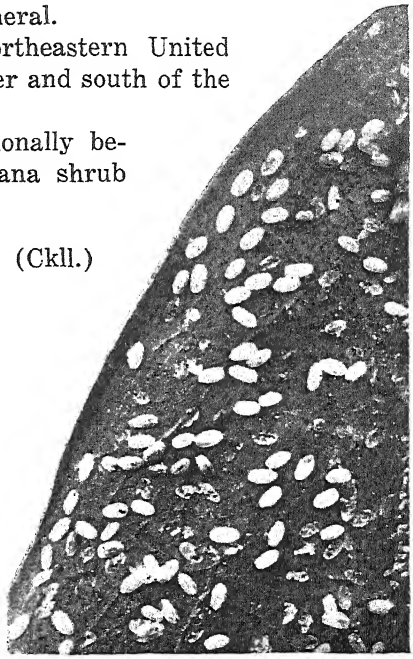


Fig. 90. — *Toumeyella liriodendri* (Gmel.) (Liriodendron Scale) Males on leaf. Enlarged twice. (After Wilson)

"The female, boiled in caustic soda, turns the liquid crimson. The eggs inside her turn bright crimson, strongly contrasting with her yellowish-brown skin. Mouth-parts very small for the size of the insect. Antennae short and broad, rudimentary, about 2½ times as broad, tipped with bristles, joints obscure. Legs equally rudimentary. Skin not tessellate, but with scattered gland-spots. The skin is very little chitinised, except in the anal region. Male scales ordinary, granular, more or less overlapping.

"Newly hatched larvae oval, pale pinkish, with two very faint suffused longitudinal dorsal bands of darker color."

Plants found infested in Florida: Pines.

Distribution in Florida: Coconut Grove, Lake City, Lawtey and Miami.

Distribution elsewhere: None found recorded.

Remarks: The above description is copied from Prof. T. D. A. Cockerell's original description in Psyche, Vol. VIII, page 90 (1897).

26. *Toumeyella turgida* (Ckll.)
(Fig. 91)

Scale of female: "Female scale $5\frac{1}{2}$ mm. long, $4\frac{1}{2}$ wide, $3\frac{1}{4}$ high. Dark reddish brown, very shiny, swollen into irregular pustule-like prominences, with large punctiform depressions between.

"Female boiled in caustic soda, turns the liquid dark sepia, and gives a slight musky odor. Dermis chitinous, orange-brown, not reticulated, presenting numerous small gland spots. Marginal spines excessively minute. Mouth parts very small, rostral loop very short. Antennae very small, short and very stout, bristly at tip, segmentation obscure. Legs, very small and stout. Coxa considerably broader than long; femur very broad, and not much longer than broad; tibia and tarsus also extremely broad; tibia a little longer than tarsus, and about one-fourth longer than broad. Claw short and stout, much curved. Digitules comparatively short, filiform.

"The embryonic larva is remarkable for the large marginal spines, about 17 on each side."

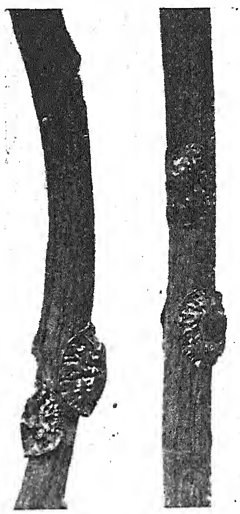


Fig. 91. — *Toumeyella turgida* (Ckll.) Slightly enlarged. (After Wilson)

Plants found infested in Florida: *Magnolia glauca* and *Magnolia grandiflora.*

Distribution in Florida: Lake City.

Distribution elsewhere: None found recorded.

Remarks: The above description is taken from Prof. T. D. A. Cockerell's original description in Psyche, Vol. VIII, page 152 (1897).

C. Mealybugs

Genus Asterolecanium Targ.

1. *Asterolecanium bambusae* Bdv. (Bamboo Scale) (Fig. 92)

Test of female: The test or covering is oval and moderately convex in shape, smooth, thin and glassy in appearance. Length, 2-2.5 mm. and from 1-1.75 mm. wide. Varying in color from transparent to a pale yellow or greenish tinge. The posterior portion is drawn out into a small, blunt point; marginal fringe consists of a double series of short, pinkish, glassy filaments which appear in pairs.

Fig. 92. — *Asterolecanium bambusae* Bdv. (Bamboo Scale) Enlarged twice.

Female: The female is under the test or covering and at the beginning completely fills it but as eggs are deposited, she becomes smaller and smaller and finally dies and dries up. The color, at first pinkish, changes to flat green, and finally brownish.

Test of male: Not observed.

Plants found infested in Florida: Bamboos.

Additional plants found infested elsewhere: None.

Distribution in Florida: General.

Distribution elsewhere: Southeastern United States; Algeria, Brazil, Ceylon, Cuba, England, Egypt, Grenada, Mauritius, Mexico, Porto Rico, South Africa, West Indies. Probably occurs throughout the tropics wherever the larger bamboo grows.

2. *Asterolecanium miliaris longum* (Green) (Fig. 93)

Test of female: Long, narrow and moderately convex in shape, thin and glassy in appearance; from 1.25-1.5 mm. in length and about .5 mm. in width; varying in color from transparent to a pale yellow or greenish tinge. The posterior portion is drawn out into a blunt point; marginal fringe short and imperfect.

Female: The insect itself is under the covering and has the same appearance as in the case of the Bamboo Scale.

Test of male: Not observed.

Plants found infested in Florida: Bamboos.

Additional plants found infested elsewhere: None.

Distribution in Florida: Coconut Grove, Key Biscayne, Miami, Oneco, Orlando, Tarpon Springs.

Distribution elsewhere: Ceylon, Cuba.

Remarks: It apparently attacks only the leaves, infesting both sides. We are indebted to Mr. E. E. Green of London, England, for comparison with the type of this species; also, for specimens from type material.

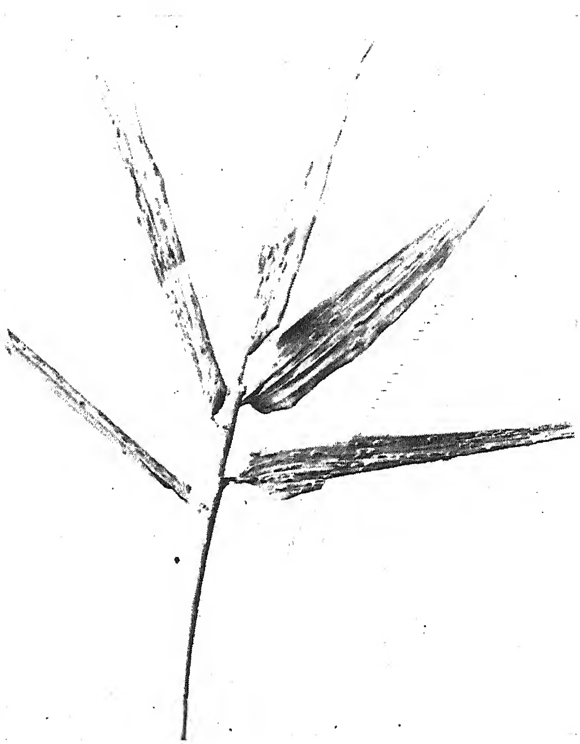


Fig. 93.—*Asterolecanium miliaris longum* (Green) Slightly enlarged.

3. *Asterolecanium pustulans* (Ckll.) (Pustule Scale)
(Fig. 94)

Test of female: Almost circular, oval and convex in shape, rough in appearance; about 2 mm. in length and nearly as broad; yellowish green to pale yellow in color. When young, the entire test is covered with short pinkish filaments. When older, they all disappear except a marginal fringe.

Female: The insect itself is under the covering as in the case of the other two species of this genus.

Test of male: Not observed.

Plants found infested in Florida: *Asclepias* sp., *Assonia* sp., Australian silk oak, *Bougainvillea* sp., bull-briar, *Carissa* sp., *Clerodendrum* sp., cork tree, cotton, crepe myrtle, *Cuphea* sp.,

custard apple, *Daedalacanthus* sp., dahoon holly, *Dombeya* sp., *Ficus* spp., fig, flame vine, grape, gumbolimbo, hackberry, *Hibiscus* sp., holly, *Jacaranda* sp., jasmine, mango, mulberry, multiply weed, oleander, orchid, passion vine, peach, pear, persimmon, *Pithecolobium* sp., poinsettia, royal poinciana, sapodilla, *Stephanotis* sp., *Symphoricarpos* sp., *Tabernaemontana* sp., *Ziziphus* sp.

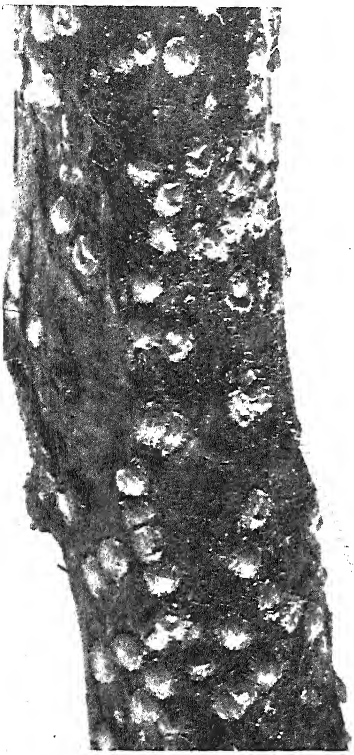


Fig. 94.—*Asterolecanium pustulans* (Ckll.) (Pustule Scale) Enlarged four times.

Additional plants found infested elsewhere: Palm, pigeon pea, Spanish bayonet.

Distribution in Florida: General.

Distribution elsewhere: California, Louisiana, New York, Southeastern United States; Antigua, Brazil, Bahama Islands, British Guiana, Cuba, Egypt, Grenada, Hawaii, Jamaica, Lower California, Mexico, Montserrat, Porto Rico, South Africa, Virgin Islands, West Indies.

Remarks: A serious pest. The presence of this insect causes a rising of the bark, forming a pustule. The insect itself lies within the crater of this abnormal formation. More noticeable on oleander and fig.

Genus CONCHASPIS Ckll.

4. *Conchaspis angraeci* Ckll.

(Fig. 95)

Test of female: Almost circular in outline, bluntly conical with the margins slightly flattened; waxy and opaque in appearance. From 1.75-2.5 mm. in diameter. Varying in color from white to creamy or grayish white. Six or eight more or less obscure ridges radiate from the apex but disappear before reaching the margin.

Female: The insect itself is under the test or covering. Oval in shape being broadly rounded posteriorly and somewhat pointed anteriorly. Dark red or purplish red in color.

Test of male: Not observed.

Plants found infested in Florida: *Acalypha* sp., croton, date palm, governor plum, *Hibiscus* spp., holly, lantana, pigeon plum, *Pittosporum* sp., red bay (?), sea grape, *Tabernaemontana* sp., wild myrtle, Wisteria.

Additional plants found infested elsewhere: *Angraecum* sp., *Rodriguezia secunda*.

Distribution in Florida: Banyan, Buena Vista, Clearwater, Homestead, Jensen, Key Biscayne, Key West, Lantana, Larkins, Little River, Miami, Palm Beach, St. Petersburg, Tampa, West Palm Beach.

Distribution elsewhere: Barbados, England, Jamaica, Mexico, Porto Rico, Trinidad.

Fig. 95. — *Conchaspis angraeci* Ckll. Enlarged about five times.

Genus Dactylopius Costa

5. *Dactylopius confusus* (Ckll.) (Cottony Cochineal) (Fig. 96)

Adult female: Oval in shape, from 3-5 mm. in length, dark red in color, and contains a large amount of red-colored fluid. Legs small and slender; antennae 7-jointed. The insect is enclosed in an irregular mass of white, cottony secretion. Several insects enclosed in each mass.

Male covering: Small, snow-white sac enclosed in masses of secretion along with females.

Plants found infested in Florida: Cactus *(Opuntia)*.

Additional plants found infested elsewhere: *Echinocactus* and *Opuntia* spp.

Distribution in Florida: General.

Distribution elsewhere: Arizona, California, Colorado, New Mexico; Cuba, Lower California, Mexico.

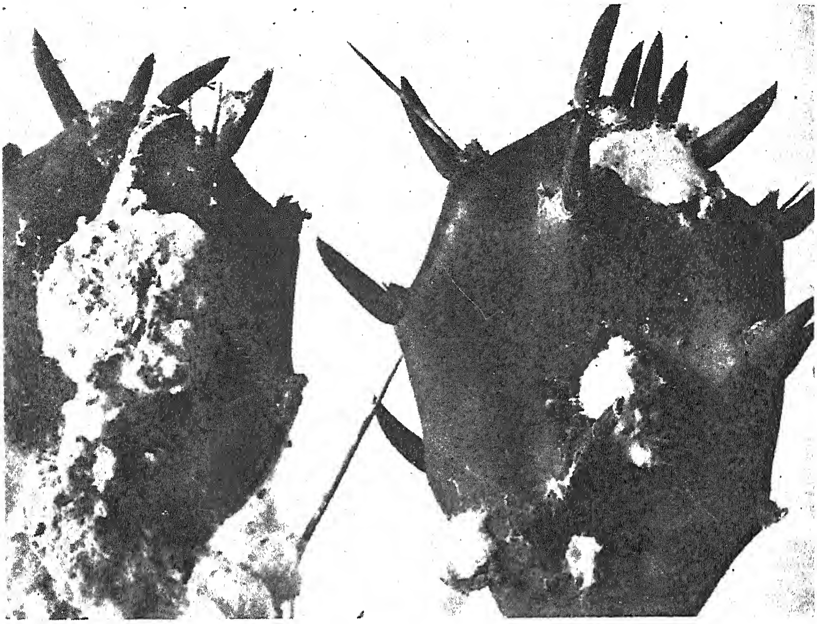


Fig. 96.—*Dactylopius confusus* (Ckll.) (Cottony Cochineal) Enlarged twice. (After Wilson)

Genus Eriococcus Targ.

6. *Eriococcus azaleae* Comst. (Azalea Eriococcus) (Fig. 97)

Adult female: Oval in shape, from 2-2.5 mm. in length, dark purple in color. Antennae 6-jointed. Enclosed in an oval shaped white felt-like sac which is covered with fine threads of wax-like secretion.

Covering of male: Similar to female but much smaller.

Plants found infested in Florida: Azalea and wild blueberry.

Additional plants found infested elsewhere: *Crataegus coccinea, Rhododendron catawbiense.*

Distribution in Florida: Miami and St. Augustine.

Distribution elsewhere: District of Columbia, Indiana, Massachusetts, Michigan, New York, Ohio.

Remarks: This insect differs from the Oak Eriococcus in that it is smaller and the sac is covered with a large amount of cottony secretion.

Fig. 97. — *Eriococcus azaleae* Comst. (Azalea Eriococcus) Enlarged.

7. *Eriococcus parvispinus* Chaffin
(Fig. 98)

Adult female: Broadly oval in shape, 2 mm. in length, dark red in color. Devoid of any secretion. Abdominal segments very distinct, legs small, slender, and of a lighter color. Antennae 7-jointed. Enclosed in an oval shaped, light yellow, felt-like sac.

Male covering: Similar to female but much smaller.

Adult: Small two-winged insect, body bright carmine in color, with four long, white, wax-like, anal filaments. Legs and antennae yellowish red.

Plants found infested in Florida: Milk pea (roots) *(Galactia volubilus)*.

Fig. 98.—*Eriococcus parvispinus* Chaffin (After Chaffin)

Additional plants found infested elsewhere: None known.

Distribution in Florida: Lake Jem.

Distribution elsewhere: Not known.

8. *Eriococcus quercus* (Comst.) (Oak Eriococcus)
(Fig. 99)

Adult female: Oval in shape, from 2.5-3 mm. in length, and of a dark red color. Body naked (without cottony secretion). Enclosed in an oval-shaped, white felt-like sac.

Covering of male: Similar to female but much smaller.

Plants found infested in Florida: Gallberry, oak.

Additional plants found infested elsewhere: Bilberry, *Vaccinium corymbosum.*

Distribution in Florida: Frostproof, Groveland, Jacksonville, Macclenny.

Distribution elsewhere: California, Georgia, Lower California, Massachusetts; Mexico.

Remarks: Insects are found in small clusters, easily noticed by white sacs in which the insects are enclosed.

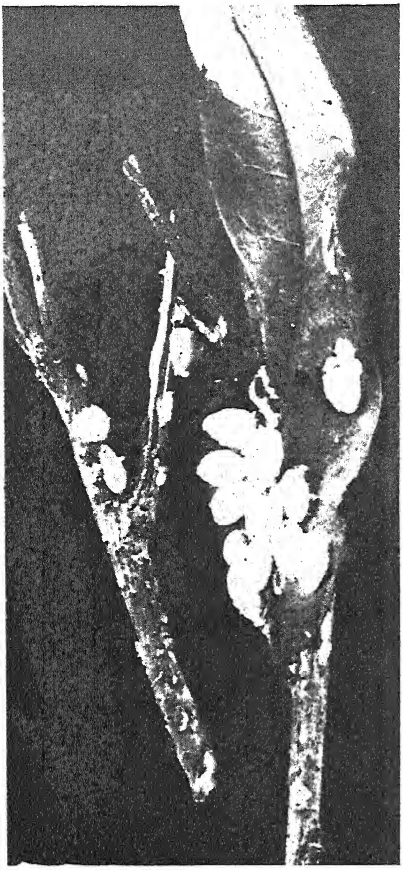


Fig. 99.—*Eriococcus quercus* (Comst.) (Oak Eriococcus) Enlarged twice. (After Wilson)

Genus ICERYA Sign.

9. *Icerya purchasi* Mask.
(Cottony Cushion-Scale)
(Fig. 100)

Adult female: Broadly oval and convex in shape. The front portion of the body is attached to and lies flat upon the surface of the plant while the abdomen is elevated by the egg sac, so that the body may occupy a position on the host at an angle of as great as 90°. The length is 4-8 mm. The color of the scale is brick-red or orange-yellow. The body is covered with a loose secretion which varies in color from white to brown. Very long, slender, waxy rods usually extend from the rim of the scale. The antennae and legs are black.

Ovisac: The egg sac from the appearance of which the scale derives its name, Cottony Cushion, is markedly convex in shape. It has a fluted or ridged appearance, is normally pure white in color, and when fully matured is much larger than the insect itself. The sac is filled with a large number of small eggs which can be readily seen with the naked eye. The eggs vary in color from light pink to red.

Adult male: The male pupates in an irregular, elongate, cottony cocoon and emerges as a small, delicate two-winged insect; body red, wings smoky, legs black, antennae brown.

Plants found infested in Florida: Acalypha, Australian pine, citrus, croton, pecan, *Pithecolobium* sp., pittosporum, rose, and many other plants.

Additional plants found infested: The host list of the Cottony Cushion-Scale is a long one and can be found in Circular 45, of the State Plant Board. Those wishing it can secure a copy by addressing the Plant Commissioner, State Plant Board, Gainesville, Florida.

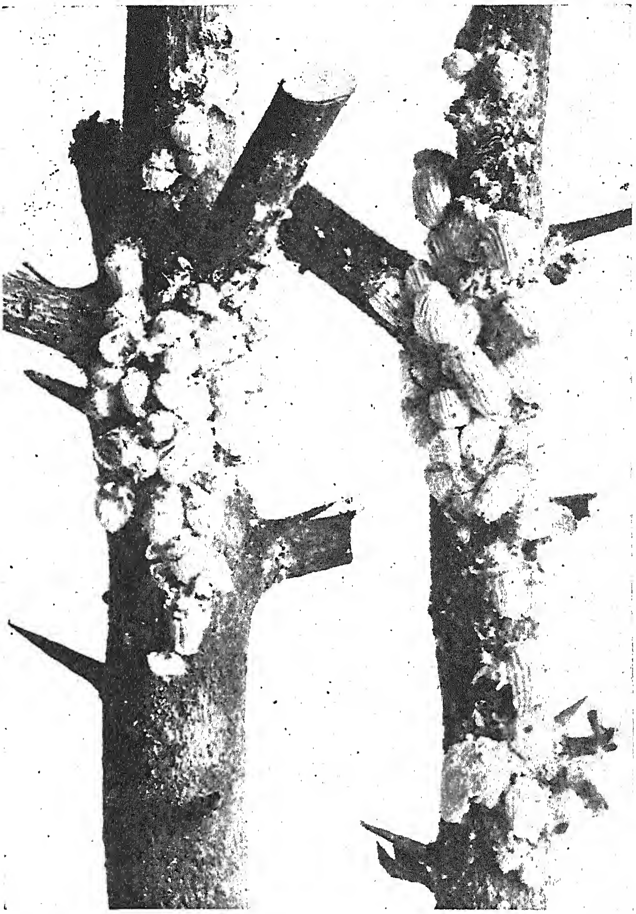


Fig. 100.—*Icerya purchasi* Mask. (Cottony Cushion-Scale) Natural size. (After Wilson)

Distribution in Florida: Scattered generally throughout the state.

Distribution elsewhere: United States; Argentine, Australia, Austria, Brazil, Ceylon, East Africa, Fiji, Formosa, France, Italy, Japan, Mexico, Morocco, New Zealand, Portugal, Sand-

wich Islands, San Thome, Sicily, South Africa, Spain, Tripoli, Uruguay, Zanzibar.

Remarks: This scale becomes quite serious at times, but is easily controlled by its natural enemy the Australian Lady-Beetle, or Vedalia, colonies of which can be obtained from the State Plant Board at a small cost.

Genus KERMES Boitard

10. *Kermes galliformis* Riley

Adult female: Globular in shape, 7 mm. broad, 6 mm. long, and 6 mm. high, almost white to dirty gray in color. Covered with minute black spots.

Male: Not observed.

Plants found infested in Florida: Oaks.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Bradentown, Gainesville, Tampa, West Palm Beach.

Distribution elsewhere: United States and probably Canada.

11. *Kermes kingii* Ckll.
(Fig. 101)

Fig. 101.—*Kermes kingii* Ckll. Enlarged four times.

Adult female: Globular in shape, 5 mm. long, 4-4.5 mm. broad, and 3.5 mm. high. Color light to bright yellow marbled with a reddish tint. Covered with numerous minute specks and small dark spots. Almost invariably found at the base of leaf petioles, or in the fork of twigs.

Male: Not observed.

Plants found infested in Florida: Oaks.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Cutler, Ft. Pierce, Gainesville, Oneco, Orlando, Tampa, West Palm Beach.

Distribution elsewhere: Delaware, Indiana, Massachusetts, Ohio.

12. *Kermes pettiti* Ehrh.

Adult female: Globular in shape, 4 mm. broad, 3 mm. long, and 3 mm. high, generally

dark purplish brown but sometimes lighter in color and marbled with brown. Distinct groove down center of back. Segments indistinct.

Male: Not observed.

Plants found infested in Florida: Water oak.

Additional plants found infested elsewhere: Oaks.

Distribution in Florida: Ft. Pierce.

Distribution elsewhere: Indiana, Massachusetts, New York, Ohio; Canada.

Genus LACHNODIELLA Hempel

13. *Lachnodiella acritocera* Chaffin

(Fig. 102)

Adult female: Broadly oval in shape. From 3.5-4 mm. in length. Grayish blue in color. Body covered with a thin coating of a fine powdery, whitish secretion. Broad, flat, rectangular-shaped, waxy filaments surround margin of body, becoming longer posteriorly, the last pair being about one-fourth the length of the body. Antennae 8-jointed.

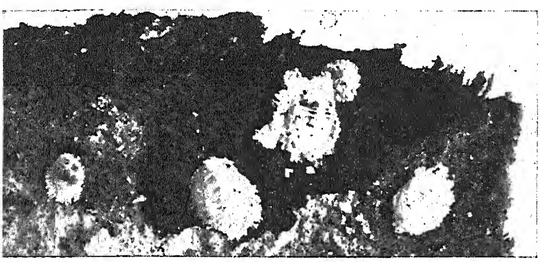


Fig. 102.—*Lachnodiella acritocera* Chaffin. Enlarged about four times. (After Chaffin)

Male: Not observed.

Plants found infested in Florida: Lancewood *(Ocotea catesbyana)*.

Additional plants found infested elsewhere: Not known.

Distribution in Florida: Miami.

Distribution elsewhere: Not known.

Genus LECANIODIASPIS Targ.

14. *Lecaniodiaspis tessellatus* Ckll.

(Fig. 103)

Adult female: Nearly circular, moderately convex in shape, and 4.5 mm. in length. Dull reddish brown in color. The body

is marked by lines of dull white secretion. These lines of secretion are not distinct on the dorsal or upper surface of the insect, but form five-sided figures along the sides of the body.


Fig. 103.— *Leaniodiaspis tessellatus* Ckll. Enlarged twice. (After Wilson)

Male: Not observed.

Plants found infested in Florida: Hickory, holly (?), *Tecoma radicans*.

Additional plants found infested elsewhere: *Diospyros virginiana*, hickory, pecan, privet.

Distribution in Florida: Ft. Myers, Gainesville, Lake City.

Distribution elsewhere: Alabama, Georgia, Mississippi.

Remarks: The above description is based on T. D. A. Cockerell's original description in Entomological News, Vol. VIII, Number 7, 1897. Not a serious pest, as yet.

Genus Margarodes Guilding (Ground Pearls)

15. *Margarodes formicarium* Guilding*

Adult female: Globular in shape, and from 2-4 mm. in length. Covered with white wax-like secretion. First pair of legs are large and fitted for digging, other two pairs are much smaller but not equipped for digging. Before emerging as an adult female, this insect is enclosed in a globular-shaped, thin walled case or shell which has a beautiful pearly lustre. The insect may remain in the larval stage in this waxy shell or cyst for years if conditions for emergence as an adult are unfavorable.

Male: Not observed.

Habitat in Florida: In the soil, apparently on the roots of plants in close proximity to ants' nests.

Habitat elsewhere: Probably the same as in Florida.

Distribution in Florida: Florida Keys.

Distribution elsewhere: Antigua, Bahama Islands, Barbados, West Indies.

16. *Margarodes rileyi* Giard
(Fig. 104)

Adult female: Very similar to above described species.

Male: Not observed.

*No specimens of this species have been seen. Description based on other authors' works.

Habitat in Florida: In the soil or sand along the beaches presumably on the roots of plants.

Habitat elsewhere: Probably the same as in Florida.

Distribution in Florida: Florida Keys.

Distribution elsewhere: Europe, West Indies.

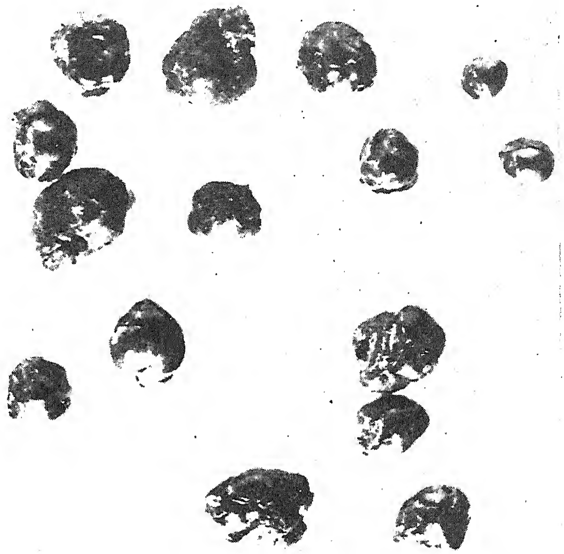


Fig. 104.—*Margarodes rileyi* Giard. Enlarged about five times.

Remarks: The cysts or shells of this little insect occur in large numbers in "pot holes" and the sand of some of the Florida Keys. The shells or cysts of the nymphal stage are of a wonderful lustre and are often strung as beads. It is reported that in small areas on some of the Keys over one-half of the soil is composed of these pearly cysts. The cysts, furthermore, appear like minute rosebuds just about to open or like very small hemlock cones, consisting of minute, curved plates closely fitting over one another.

Genus ORTHEZIA BOSC.

17. *Orthezia insignis* Dougl. (Greenhouse Orthezia) (Fig. 105)

Adult female: Oval in shape and from 1.5-2 mm. in length. Varying in color from dark green to black. There is a row of broad, white, waxy filaments or plates around the margin of the body from the head back and a double row on the dorsum or upper surface of the body, extending from the head to about three-fourths the length of the insect. Legs and antennae brownish in color. The egg sac is snow-white in color, from 2-4 times as

long as the female and has several longitudinal ridges which give it a fluted appearance.

Male: Not observed.

Plants found infested in Florida: *Daedalacanthus* sp., ironweed, lantana, Spanish needle, yellow elder.

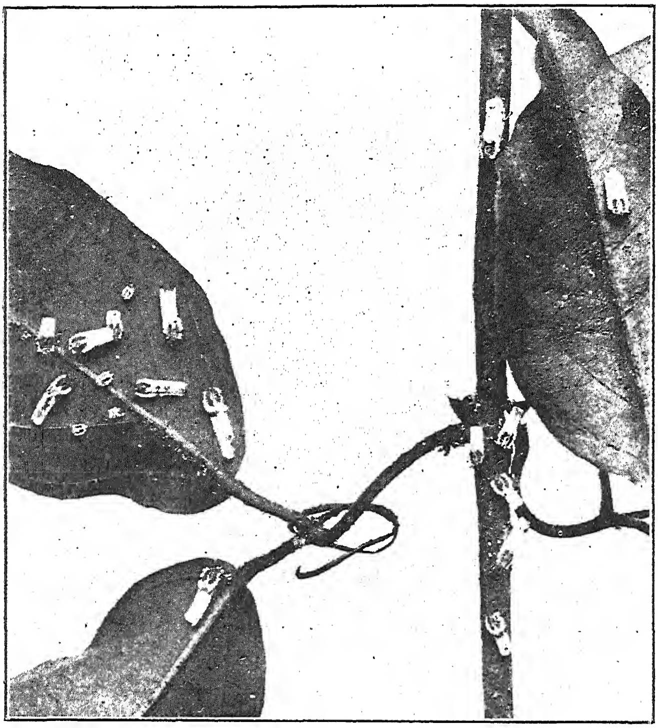


Fig. 105.—*Orthezia insignis* Dougl. (Greenhouse Orthezia) Slightly enlarged. (After Essig)

Additional plants found infested elsewhere: *Achillea* sp., *Ageratum* sp., *Bignonia* sp., *Capsicum* sp., chrysanthemum, citrus, coleus, *Cuphea* sp., *Gardenia* sp., *Ipomoea* sp., *Lonicera* sp., moonflower, pepper, pigweed, sage, *Salvia* sp., strawberry, *Strobilanthus* sp., tea, *thunbergia* sp., tomato, verbena, *Vernonia* sp., yarrow.

Distribution in Florida: Avon Park, Miami, Mt. Dora, Oneco.

Distribution elsewhere: United States, Brazil, British Guiana, Ceylon, China, Dominica, England, Germany, India, Jamaica, Mauritius, Mexico, Porto Rico, San Thome, South Africa, Trinidad. (Tropicopolitan.)

Remarks: May become a serious pest in Florida.

Genus PALAEOCOCCUS Ckll.

18. *Palaeococcus rosae* (R. & H.) (Rose Palaeococcus) (Fig. 106)

Adult female: Broadly oval in shape, from 4-6 mm. in length, bright red in color. Body covered with a thick coating of yellowish, powdery secretion and many short hairs. Short waxy filaments around margin of body. Abdominal segments very distinct. Head and antennae black.

Male: Not observed.

Plants found infested in Florida: Rose.

Additional plants found infested elsewhere: *Amherstia nobilis,* citrus, *Euphorbia* sp., guava, *Hakea gibbosa,* lignum-vitae, *Prosopis julifera,* sugar apple.

Distribution in Florida: Key West.

Distribution elsewhere: Australia, Cuba, Jamaica, Mexico.

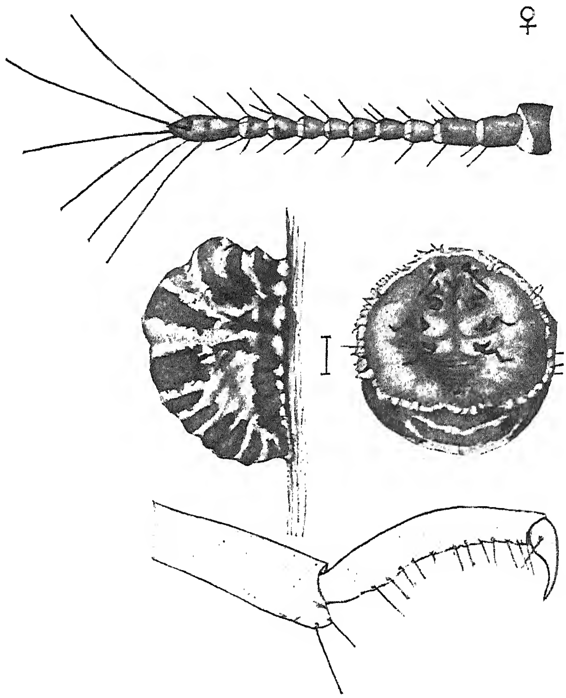


Fig. 106.—*Palaeococcus rosae* (R. & H.) (Rose Palaeococcus) Above, antennae of female; at left, pregnant female, side view; at right, same, ventral view; below tarsus of female. (From Insect Life, Vol. III, p. 96, U. S. Dept. of Agr.) (After Riley and Howard)

Remarks: Somewhat resembles matured, or nearly matured, cottony cushion-scale without the egg sac.

Genus PHENACOCCUS Ckll.

19. *Phenacoccus colemani* Ehrhorn

Adult female: Oval in shape and from 2.5-3 mm. in length, light yellowish pink in color. Body covered with a very thin coating of fine, powdery, whitish secretion, but no filaments or

tassels present around margin of body. Legs and antennae light brown in color. Antennae 9-jointed.

Male covering: Not observed.

Plants found infested in Florida: Palm.

Additional plants found infested elsewhere: *Castilloa* sp., *Ericophyllum confertiflorum*, *Rubus* sp., *Rubus vitifolius*, wild strawberry.

Distribution in Florida: Fort Myers, Lakeland.

Distribution elsewhere: California.

Remarks: Impossible to distinguish from *Phenacoccus solani* without the aid of a good microscope.

20. *Phenacoccus solani* (Ckll.)
(Fig. 107)

Adult female: Oval in shape, from 2.5-3 mm. in length, light yellowish pink in color. Body lightly covered with thin coating of a fine, powdery, whitish secretion, but no filaments or waxy tassels present. Legs and antennae light brown in color. Antennae 8-jointed.

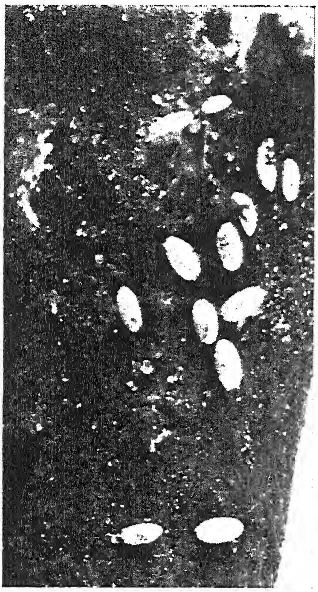


Fig. 107. — *Phenacoccus solani* (Ckll.) Enlarged three times.

Male covering: Not observed.

Plants found infested in Florida: Cowpea, peanut, ragweed and unknown legume.

Additional plants found infested elsewhere: Aster, farweed, *Malva* sp., nightshade, potato, purslane, sunflower, tomato, wild raddish.

Distribution in Florida: General.

Distribution elsewhere: California, New Mexico.

Remarks: Generally found on the roots of plants.

Genus Pseudococcus Westw.

21. *Pseudococcus bromeliae* (Bouche) (Pineapple Mealybug)
(Fig. 108)

Adult female: Broadly oval in shape, about 3 mm. in length, pale pink or almost white in color, covered with a thick coating

of white powdery secretion, and long distinct wax filaments around margin of body. The last four pairs are longer than the others and project backward, the inner or caudal pair being about one-third to one-half the length of the body and very little longer than the other three pairs. Segments very distinct, antennae 8-jointed.

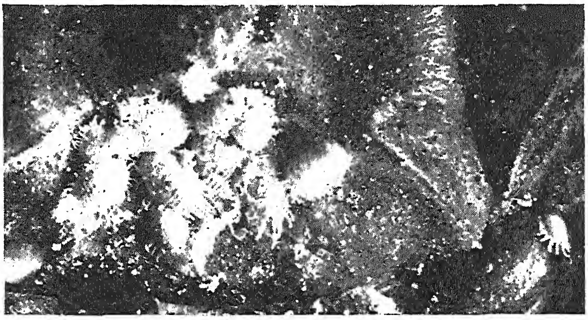


Fig. 108.—*Pseudococcus bromeliae* (Bouche) (Pineapple Mealybug) Enlarged about four times.

Male covering: Small, white, cottony secretion, tubular in shape.

Plants found infested in Florida: Banana, caladium, citrus, mangrove, pineapple, royal palm, sugar cane.

Additional plants found infested elsewhere: Breadfruit, canna, hibiscus, *Impatiens* sp., mulberry, sweet potato.

Distribution in Florida: Arcadia, Bartow, Cleveland, Dunnellon, Florence Villa, Fort Meade, Fort Myers, Lakeland, Lucerne Park, Punta Gorda, Winter Haven, and along the east coast wherever pineapples are grown.

Distribution elsewhere: Massachusetts; Australia, Canary Islands, Cuba, Hawaii, Honduras, India, Nassau (Bahama Islands), South Africa, South America, West Indies, Zanzibar.

22. *Pseudococcus citri* (Risso) (Common Mealybug) (Fig. 109)

Adult female: Oval in shape and from 2.5-4 mm. in length, light amber in color and covered with white powdery wax-like secretion. Short but distinct filaments or tassels of secretion are around the edge of the body, becoming longer toward the posterior end. The caudal or last pair are about one-fourth the length of the insect. The legs and antennae are brownish. Eggs of the insect are deposited in large, irregular masses of cottony secretion.

Male covering: Small, white, delicate, cottony sac.

Plants found infested in Florida: Acalypha, avocado, banana, cactus, canna, cape jasmine, celery, chrysanthemum, citrus, *Cissus secyoides*, coleus, croton, *Ficus* sp., fig, geranium, grape, guava, hibiscus, *Impatiens* sp., japonica, lantana, mastic, mint, oleander, palmetto, palm, persimmon, pineapple, pomegranate, potato, ragweed, royal palm, *Stephanotis* sp., sweet potato, wandering Jew, Wisteria.

Fig. 109.—*Pseudococcus citri* (Risso) (Common Mealybug) Enlarged three times.

Additional plants found infested elsewhere: A complete list of host plants of this pest would require too much space to list here.

Distribution in Florida: General.

Distribution elsewhere: Alabama, California, Georgia, Illinois, Indiana, Iowa, Louisiana, Massachusetts, North Carolina, New Jersey, New York, Pennsylvania, Ohio, South Carolina; Brazil, Canada, Canary Islands, Cuba, Europe, Isle of Pines, Jamaica, Mauritius, Porto Rico, Sandwich Islands, probably cosmopolitan.

Remarks: The most common and, as a whole, the most injurious mealybug in the state. A severe pest of citrus during dry weather and a nuisance in greenhouses and ornamental gardens throughout the year. It multiplies very rapidly, each female laying from 300 to 500 eggs, and there are often as many as four generations a year in Florida. This insect secretes a large amount of honey-dew.

23. *Pseudococcus comstocki* Kuw. (Comstock's Mealybug)

Adult female: Broadly oval in outline and about 2.5 mm. long. Color generally light grayish pink. Covered with a moderately thick coating of white powdery secretion. Wax filaments around margin of body short and slender, becoming longer posteriorly, the anal pair being about one-third the length of the body.

Male covering: A small, white, cottony sac.

Plants found infested in Florida: Pigeon plum *(Cocolobis laurifolia)*.

Additional plants found infested elsewhere: Maple, Monterey pine *(Pinus radiata)* and mulberry.

Distribution in Florida: Miami.

Distribution elsewhere: California, New York, Ceylon and Japan.

24. *Pseudococcus juniperi* Ehrh.

(Fig. 110)

Adult female: Broadly oval in shape, from 1.5-2 mm. in length, dark red in color, body covered with a coarse, whitish, powdery secretion, except two narrow longitudinal stripes. Waxy filaments around margin of body, short, stubby and indistinct. Legs very slender, antennae 8-jointed.

Male covering: Not observed.

Plants found infested in Florida: *Sabina* sp.

Additional plants found infested elsewhere: *Juniperus copulorum, Juniperus pachyphlola, Juniperus virginiana.*

Distribution in Florida: Elfers, Hudson, Port Richey.

Distribution elsewhere: Arizona, New Mexico.

Fig. 110.—*Pseudococcus juniperi* Ehrh. Enlarged about four times.

25. *Pseudococcus longispinus* (Targ.) (Long-tailed Mealybug)

(Fig. 111)

Adult female: Oval in shape and from 2.4-3 mm. in length, grayish to light yellow in color, covered with a fine powdery, wax-

like, whitish, secretion. It is easily distinguished by the unusually long filaments or tassels. Those around the margin of the body are often equal in length to half the width of body. The four anal tassels give the insect the appearance of having a long tail. The caudal pair are often longer than the body.

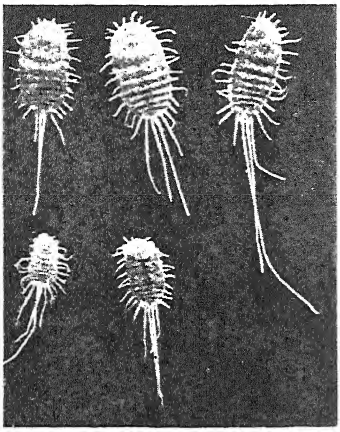


Fig. 111. — *Pseudococcus longispinus* (Targ.) (Long-tailed Mealybug) Greatly enlarged. (After Sanders)

Male covering: Small, white, cylindrical mass of secretion.

Plants found infested in Florida: Acalypha, *Aralia* sp., avocado, bamboo, banana, beet, cactus, canna, *Carissa* sp., citrus, coconut, croton, eucalyptus, fern, *Ficus* sp. guava, lily, *Malva* sp., mango, oleander, orchid, palm, pandanus, pothos, persimmon, *Plumeria* sp., screw pine, star apple, wax vine, Wisteria.

Additional plants found infested elsewhere: Begonia, calla, camellia, coleus, fig, grape, moonflower, opuntia, plum, umbrella plant.

Distribution in Florida: General.

Distribution elsewhere: California, Indiana, New York, Ohio, Pennsylvania, Virginia; Australia, Bahama Islands, Chili, Cuba, Europe, Isle of Pines, Jamaica, Mauritius, New Zealand. Probably whole U. S. and probably cosmopolitan.

Remarks: Strictly speaking, this species should be called *adonidum*, but we are retaining the name *longispinus* because it has been in use for a long time and is better known.

26. *Pseudococcus maritimus* (Ehrh.)
(Baker's Mealybug)
(Fig. 112)

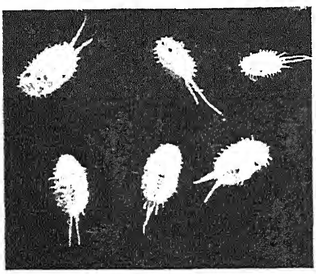


Fig. 112.—*Pseudococcus maritimus* (Ehrh.) (Baker's Mealybug) Enlarged about four times.

Adult female: Oval in shape and from 2.5-3 mm. in length, dull grayish pink in color. Covered with very thick coating of a fine, white, powdery secretion. Short, waxy filaments around margin of body, last four longer, the inner pair being

from one-half to three-fourths the length of the body. Legs long and slender, antennae 8-jointed.

Male covering: Not observed.

Plants found infested in Florida: Avocado, cedar, sweet potato, tomato.

Additional plants found infested elsewhere: Apple, buckeye, carnation, *Crataegus* sp., elder, English ivy, English walnut, *Erigonum latifolium*, grape, *Grevillea* sp., lemon, magnolia, Mexican orange, nightshade, orange, *Passiflora* sp., passion flower, pear, *Pinus radiata*, potato, potato vine, Japanese quince, *Quercus agrifolia*, wild sunflower, wild cherry, willow.

Distribution in Florida: Dry Tortugas Island, Hudson, Port Richey.

Distribution elsewhere: California, Missouri, New York, Oregon; Ceylon, Cuba, England, Lower California.

Remarks: This insect is a very serious pest of the grape in California. Ferris says: "It is probable that there is almost no cultivated or wild flowering plant upon which it will not feed."

27. *Pseudococcus nipae* (Mask.) (Coconut Mealybug) (Fig. 113)

Adult female: Oval in shape, from 1.5-3 mm. in length, rich amber in color. The body is covered with thick, conical-shaped humps or plates of coarse, slightly yellowish, wax-like secretion arranged in rows. The thick wax-like plates give the insect much the appearance of the first or second immature stages of the common Florida Wax Scale. Antennae 7-jointed.

Male covering: Small, snow-white, elongated, felt-like mass of secretion and very numerous.

Plants found infested in Florida: *Anona* sp., avocado, cassava, cabbage palmetto, coconut, croton, custard apple, fern, guava, Mammea apple, mulberry, *Ochracarps africans*, palms, pigeon plum, rose, royal poinciana, sapodilla, sea grape *(Coccolobis uvifera)*, star apple, wild myrtle.

Additional plants found infested elsewhere: *Nipa fruticans*, palm.

Distribution in Florida: General in south Florida; in north Florida at present confined mostly to greenhouses.

Distribution elsewhere: California, Indiana, Massachusetts, New York, Ohio; British Guiana, Cuba, Demerara, Mexico, Nassau (B. I.), Porto Rico.

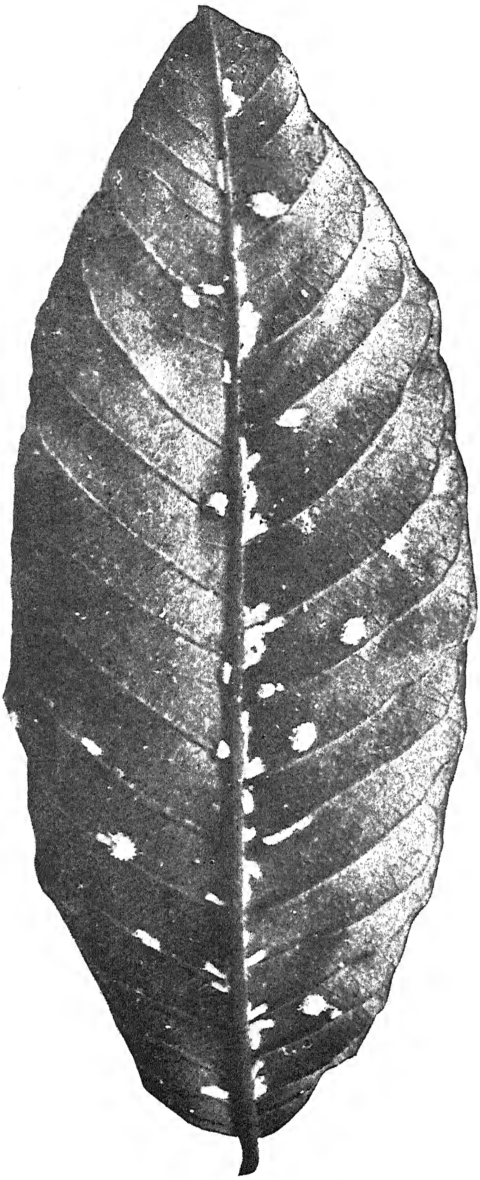


Fig. 113.—*Pseudococcus nipae* (Mask.) (Coconut Mealybug) Enlarged twice. (After Wilson)

Remarks: During dry weather this insect multiplies rapidly and does serious damage to guavas, avocados, palms, sapodillas and other plants in the southern part of the state. It excretes a large amount of honey-dew.

28. *Pseudococcus virgatus* (Ckll.)
(Fig. 114)

Adult female: Body long and slender, from 3.5-4.5 mm. in length, dark purple in color. Covered with a thin coating of very fine, white, powdery secretion and numerous delicate, silken, waxy threads. Two long, narrow, dark areas partially devoid of secretion, extend lengthwise on the body. The last pair, or caudal filaments, are about half the length of the body. Legs and antennae pale brown in color. Antennae 8-jointed.

Male covering: Small, white, cocoon-like woolly secretion, cylindrical in shape.

Plants found infested in Florida: Avocado, croton, magnolia, mulberry, oleander, plum, Spanish needle.

Additional plants found infested elsewhere: Acalypha, asparagus, cactus, *Castilloa elastica*, cotton, *Lilium* sp., palm, *Portulaca* sp., *Psidium* sp., *Sagitaria* sp., *Talinum* sp., tomato, violets.

Distribution in Florida: General.

Distribution elsewhere: Texas; Hawaii, Jamaica, Lower California, Mauritius, Mexico, Nicaragua, Philippine Islands, Sandwich Islands.

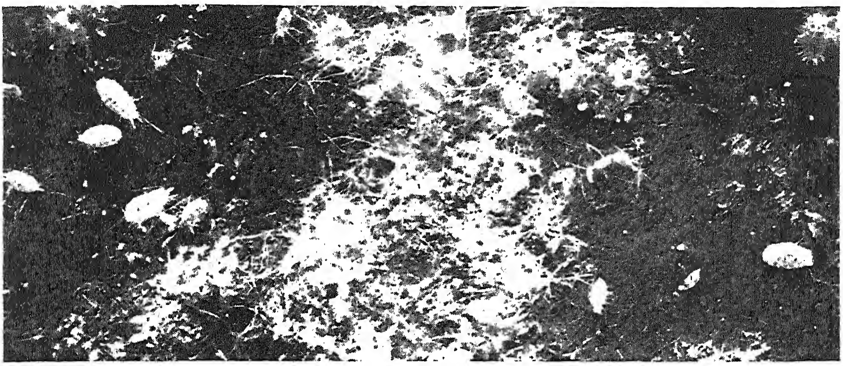


Fig. 114.—*Pseudococcus virgatus* (Ckll.) Enlarged twice.

Remarks: Sometimes, during the summer months, the entire under side of every leaf on a magnolia tree will become covered with this insect and its cast-off skins. It excretes a large amount of honey-dew.

Genus TRIONYMUS Berg.

29. *Trionymus calceolariae* (Mask.) (Sugar-Cane Mealybug) (Fig. 115)

Adult female: From 3.5-4.5 mm. in length, grayish pink in color, body covered with thin coating of white, powdery secretion. Short, wax-like filaments or tassels occur around the margin of the body. The last four at the posterior end are much longer, the inner ones, or caudal pair, being about one-fourth the length of the insect.

Male: Not observed.

Plants found infested in Florida: Sugar cane.

Additional plants found infested elsewhere: Calceolaria, *Cassinia* sp., *Cordyline australis*, *Danthonia* sp., Johnson grass, *Phormium tenax*, *Traversia* sp.

Fig. 115.—*Trionymus calceolariae* (Mask.) (Sugar-Cane Mealybug) Enlarged four times.

Distribution in Florida: Canal Point, Boynton, Hypoluxo, Okeechobee City, Punta Gorda, Port Richey.

Distribution elsewhere: Alabama, California, Georgia, Louisiana, Mississippi; Australia, Cuba, Fiji Islands, Jamaica, New Zealand, Porto Rico, Sandwich Islands, South America.

Remarks: This is a serious pest of sugar cane.

30. *Trionymus quaintancii* (Tinsley)
(Fig. 116)

Adult female: About 2 mm. in length, dark gray in color, body covered with a thick coating of evenly distributed white, powdery secretion, along with numerous delicate, silky, waxen threads. No distinct filaments present around margin of body except one short, stout pair on caudal segment. Legs and antennae large and strong. Eggs deposited in irregular mass of powdery secretion.

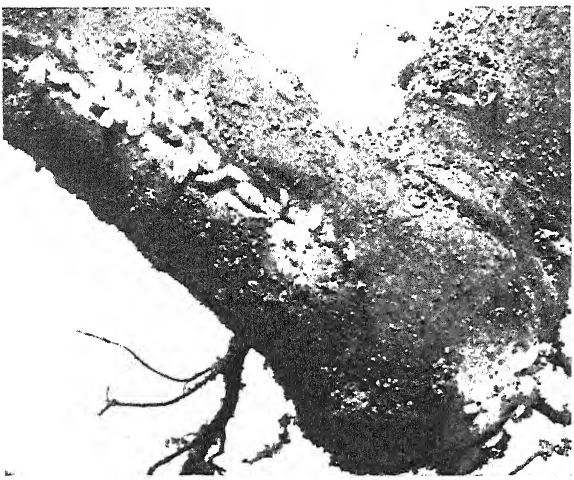


Fig. 116.—*Trionymus quaintancii* (Tinsley) Enlarged about three times.

Male: Not observed.

Plants found infested in Florida: Pineapple, ragweed, sumac.

Additional plants found infested elsewhere: *Rhus capallina.*

Distribution in Florida: General.

Distribution elsewhere: Cuba.

Remarks: This species has been transferred to the genus *Trionymus* because its characters indicate very clearly that it is nearer that genus than the genus *Pseudococcus.* Professor G. F. Ferris, of Stanford University, under date of March 19, 1923, writes as follows: "I have never published the change of name of *Pseudococcus quaintancii.* The species, however, comes much closer to *Trionymus* (as I defined it in my paper on the California mealybugs). The whole question of generic limits in this group is very complex and definite limitations can hardly be set that will apply everywhere, but I think this species goes better as *Trionymus.* You are quite at liberty to utilize this note."

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.......... *Editor*

ASSOCIATE EDITORS

E. W. BERGER.......... *Entomologist*
F. M. O'BYRNE.......... *Nursery Inspector*
FRANK STIRLING.......... *General Inspector*
J. H. MONTGOMERY.......... *Quarantine Inspector*
O. F. BURGER.......... *Plant Pathologist*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK IN COOPERATION WITH THE BUREAU OF PLANT INDUSTRY, FOR QUARTER ENDING JUNE 30, 1923

Citrus grove trees inspected	3,002,198
Citrus nursery trees inspected	15,599,638
Inspectors employed	89
Inspectors employed on canker eradication	47
New properties showing active infection	1
Total properties showing active infection	5
Grove trees found infected	6
Nursery trees found infected	0
Counties in which active infections were found	1

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914,	15,150
Nursery trees found infected since May, 1914,	342,260
Number of properties infected to June 30, 1923,	510
Properties declared no longer "Danger Centers"	486
Properties still classed as "Infected" June 30, 1923,	24

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to June 30, 1923:

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Jan.	....	306	86	14	0	0	0	0	0	1
Feb.	....	165	21	4	1	0	0	0	0	1
Mar.	....	444	49	9	1	1	0	0	0	2
Apr.	....	408	49	169	2	1	0	0	0	3
May	108	1042	338	52	1	1	0	0	585	2
Jun.	160	772	450	45	10	0	0	0	168	1
Jul.	275	651	349	39	0	0	539	0	28	....
Aug.	1313	1345	219	30	0	1	1	0	34	....
Sep.	767	618	124	6	0	0	0	0	23	....
Oct.	565	214	451	2	0	0	0	0	19	....
Nov.	773	494	131	1	0	0	0	0	12	....
Dec.	366	256	27	1	0	0	0	0	4	....
Total	4327	6715	2294	372	15	4	540	0	873	....

BEE DISEASE ERADICATION

Report for Quarter Ending June 30, 1923

Number of apiaries inspected	315
Number of apiaries infected with American Foul Brood	4
Number of colonies inspected	7,946
Number of colonies infected with American Foul Brood	6
Number of apiaries infected with European Foul Brood	0
Number of colonies infected with European Foul Brood	0

QUARANTINE DEPARTMENT

Quarantine Inspector's Quarterly Summary for All Ports and Stations for Quarter Ending June 30, 1923

Ships and Vessels Inspected:

From foreign ports	607	
From U. S. ports other than Florida	430	
From Florida ports	233	
Total		1,270

Number of Parcels Inspected:

Arriving by water:

Passed	1,104,160	
Treated and passed	22,056	
Returned to shipper	213	
Contraband destroyed	363	
Total		1,126,792

Arriving by land—express, freight, wagon, etc.:

Passed	3,527	
Treated and passed	5,916	
Returned to shipper	85	
Contraband destroyed	90	
Total		9,618

Arriving by mail:		
Passed	436	
Treated and passed	9	
Returned to shipper	20	
Contraband destroyed	27	
Total		492
GRAND TOTAL OF PARCELS INSPECTED		1,136,902
Number of parcels on hand pending determination as to final disposition	327	

The most important interception during the quarter was that of Mexican Orange Maggot *(Anastrepha (Trypeta) ludens* Loew.) The maggots were discovered by Inspectors Zeluff and Potter in oranges in ship stores on a vessel from Tampico, Mexico, arriving at Tampa. This is the first interception of this very destructive fruit fly at any Florida port, although inspectors have been constantly on the alert. The Mexican Orange Maggot has occasioned great losses in the fruit plantings of Mexico and elsewhere. The insect has numerous host fruits other than citrus and would without doubt become equally destructive in Florida and the other Gulf states if it once gains entrance. Inspectors Zeluff and Potter are to be congratulated on this important find.

FEDERAL QUARANTINE ON FOREIGN FRUITS AND VEGETABLES

Just as we go to press we are in receipt of an announcement from the Federal Horticultural Board promulgating a quarantine on importation of fruits and vegetables from foreign countries. With the quarantine order, which was issued by the Secretary of Agriculture, Hon. Henry C. Wallace, were also certain regulations and rules under which specified fruits may be imported; also a press statement from Doctor C. L. Marlatt, Chairman of the Federal Horticultural Board. We publish herewith the quarantine order, known as Quarantine No. 56, and the statement of the Chairman of the Board. The rules and regulations are too extensive for reproduction in this issue of the Bulletin. Florida growers will be glad to learn of this action of the Department of Agriculture. It provides an additional and much-needed protection and Florida horticulturists should be duly appreciative.

UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
FEDERAL HORTICULTURAL BOARD

FRUIT AND VEGETABLE QUARANTINE

Notice of Quarantine No. 56, With Regulations.

(Effective on and after November 1, 1923.)

The fact has been determined by the Secretary of Agriculture, and notice is hereby given, (1) that there exist in Europe, Asia, Africa, Mexico, Central and South America, and other foreign countries and localities, certain injurious insects, including fruit and melon flies (*Trypetidae*), new to and not heretofore widely distributed within and throughout the United States, which affect and may be carried by fruits and vegetables commercially imported into the United States or brought to the ports of the United States as ships' stores or casually by passengers or others, and (2) that the unrestricted importation of fruits and vegetables from the countries and localities enumerated may result in the entry into the United States of injurious insects, including fruit and melon flies (*Trypetidae*).

Now, therefore, I, Henry C. Wallace, Secretary of Agriculture, under authority conferred by the act of Congress approved August 20, 1912, (37 Stat., 315), do hereby declare that it is necessary, in order to prevent the introduction into the United States of certain injurious insects, including fruit and melon flies (*Trypetidae*), to forbid, except as provided in the rules and regulations supplemental hereto, the importation into the United States of fruits and vegetables from the foreign countries and localities named and from any other foreign country or locality, and of plants or portions of plants used as packing material in connection with shipments of such fruits and vegetables.

On and after November 1, 1923, and until further notice, the importation from all foreign countries and localities into the United States of fruits and vegetables, and of plants or portions of plants used as packing material in connection with shipments of such fruits and vegetables, except as provided in the rules and regulations supplemental hereto, is prohibited.

This quarantine leaves in full effect all special quarantines and other orders now in force restricting the entry into the United States of fruits and vegetables with the exception of Quarantine No. 49, with regulations, on account of the citrus black fly, which is replaced by this quarantine. A list of such quarantines and restrictive orders is given in Appendix A of the rules and regulations supplemental hereto.

Done this first day of August, 1923.

Witness my hand and the seal of the United States Department of Agriculture.

HENRY C. WALLACE,
(Seal) Secretary of Agriculture.

PROHIBITION ON IMPORTS OF FRUITS AND VEGETABLES

Washington, August 15.—As a step toward keeping certain injurious fruit and melon flies out of the United States, the Federal Horticultural Board, United States Department of Agriculture, has placed a quarantine on all fruits and vegetables offered for import, except from Canada, on and after November 1. No new prohibitions are placed on commodities from Mexico. These insects are known to be serious crop pests in various parts of the world, and as yet have not made their way into the United States,

where it is thought they would cause severe damage to our fruits and vegetables.

Under special permit shipments of certain fruits and vegetables may be brought into the country at the discretion of the board. Application for permits must be made to the Federal Horticultural Board at Washington, D. C. Full information concerning the intended shipment must be given in the application.

Action was taken by the department following a hearing some months ago at which all interests concerned were present. Restrictions on bringing in fruits and vegetables from outside countries were considered necessary for the protection of American crops. Copies of the regulations will be available in a few weeks and may be had upon application to the Federal Horticultural Board, United States Department of Agriculture, Washington, D. C.

In connection with its action, the Federal Horticultural Board made the following statement:

"The purpose of Quarantine No. 56 is to safeguard the American fruit and vegetable crops from the danger of fruit flies and related pests. The quarantine and regulations thereunder are based on the hearing of December 19, 1922. The restrictions on the entry of fruits and vegetables provided for in the regulations are believed to be the least which will give such protection.

"The fruits and vegetables which are open to entry under the quarantine, and the restrictions on such entry, are indicated in Regulation 2. It will be noted that the articles which may be imported include the principal items which have hitherto been important commercial factors.

"No restrictions are placed on imports from Canada under this quarantine, and no prohibitions are placed on fruits and vegetables from Mexico other than those that have been long in force on account of the Mexican fruit fly, avocado weevil, and certain potato pests. The authority to import citrus fruit from the West Indies through northern ports, in addition to the imports of fruits and vegetables authorized from all foreign countries, limits the prohibitions as to the West Indies largely to certain tropical fruits, the commercal imports of which have been hitherto unimportant—the danger, in fact, being largely due to the occasional small lots brought in by passengers or as ships' stores.

"It may be pointed out that the countries which have for us the greatest danger from fruit flies and related pests, such as those of Africa and the sub-tropical and tropical regions of Europe, Asia, and South America, and the countries and islands of the Pacific, are permitted under the quarantine to export to the United States important fruits and many vegetables, the same, in fact, as are permitted from the Temperate and more northern countries. The excluded fruits other than oranges from the subtropical and tropical countries and islands are for the most part of small commercial importance, such as fresh figs, peaches, plums, apricots, and other rather perishable fruits, and the strictly subtropical and tropical fruits; in other words, the fruits involving the greatest danger from fruit flies.

"The special provision made under Regulation 2 for imports of fruits and vegetables from the States of Victoria, South Australia, and Tasmania, of the Commonwealth of Australia, and from the countries of Chile and Argentina is based on the assurances which have been received from the responsible officials of these countries as to the freedom of these countries and States from fruit fly, with the exception of Argentina, and the freedom also of important districts of Argentina from which exports are proposed. It is understood that the continuation of the permission to so import with respect to these countries is subject to such change as the actual condition of imports, or as other information as to fruit fly infestation, may later warrant.

"The board believes that the permitted fruits and vegetables are reasonably safe, but if there is any risk with respect to these, the provision in the regulations for inspection and control at port of arrival will give oppor-

tunity to safeguard or, if necessary, to exclude any shipment. If, as a result of such inspection, fruits or vegetables are found to be infested with dangerous pests, such finding may be made the basis for any additional restrictions which may be necessary.

"That the danger of entry of important fruit fly and other pests in connection with imports of fruits and vegetables is a very real one is clearly indicated by the many interceptions of infested fruits and vegetables which have been made at various ports of entry, both by Federal and State inspectors. Many of these interceptions have been in connection with fruits brought in by passengers or by ships' crews or as a part of ships' stores, but others have been in connection with commercial shipments. Leaving out of consideration the hundreds of interceptions of fruits from Mexico infested by the Mexican fruit fly and of fruits and vegetables from Hawaii infested with the Mediterranean fruit fly and with the melon fly, there are many records of interceptions of infested fruits and vegetabes from such other and widely separated parts of the world as South Africa, Belgian Congo, China, Mediterranean countries, and trans-Pacific countries and islands. From sources nearer to us, many interceptions have been made of infested subtropical fruits from the West Indies and various Central American and South American countries. Furthermore, it should be pointed out that these interceptions have resulted from the inspection of a very small percentage of the actual imports. Except as to the ports of California and Florida, and in very recent years, New Orleans, no thoroughgoing inspection has been maintained of fruit and vegetable entries. That this country has not become invaded by fruit flies, the worst of all fruit pests, is therefore more a matter of good fortune than otherwise.

"The danger is, furthermore, a rapidly growing one with the increase of world commerce and especially with the shortening of time between countries by the building of speedier ships. As an example, it is now possible to send fairly perishable fruit, such as peaches, apricots, melons, etc., from South Africa to New York and to have such fruit cross the continent to San Francisco! A portion of a shipment of nectarines so routed from South Africa was intercepted in California and found infested with fruit fly larvae! It is known also that various foreign countries invaded with fruit flies are making preparations to increase their fruit and vegetable exports to the United States, and some of the occasional shipments which have already reached us from such countries have, as just noted, proved to be infested with fruit flies. The risk which will follow the more frequent and larger shipments which are in prospect is evident, and the necessity for taking prompt measures to protect the American fruit cultures from these pests would seem to require no further argument."

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. VIII October, 1923 No. 1

FIELD WORK IN FLORIDA DURING THE YEAR ON DISEASE CONTROL

By G. F. WEBER*

The eradication of citrus canker, *Bacterium citri* (Hasse) Jehle, has been pushed vigorously during the past year. At the present time there are fifteen inspectors on the force at Davie, Florida. The last infection reported was on June 4th, 1923, with the exception of the discovery of an isolated case on October 17th, 1923. This dreaded disease is becoming more and more a thing of the past and with the stringent quarantine laws enforced, it should, in the near future, be entirely eliminated from the state. The Pathologist of the Experiment Station has carried on considerable experimental work with the causal organism. A special greenhouse has been erected wherein extensive pathological work including inoculation of the many citrus species and varieties and different soil types has been conducted. The causal organism has been studied in the laboratory and the knowledge concerning it has been added to materially.

A recent bulletin (Florida Agricultural Experiment Station Bulletin No. 167) by Dr. O. F. Burger[1], Mr. E. F. DeBusk[2], and Mr. W. R. Briggs[3], includes an abundance of information about the melanose disease of citrus fruits. The occurrence, importance and distribution of the disease are discussed. It is also well described. The causal organism *(Phomopsis citri* Faw.) has been cultured and inoculation experiments conducted. The disease is effectively controlled by spraying, with bordeaux-oil-emulsion, at certain periods of development of the fruits. The control work is being continued in an experimental way during the present season from the commercial standpoint.

Citrus scab *(Cladosporium citri* Massee) is well distributed in Florida and has caused considerable damage. During the past year Mr. J. R. Winston of the United States Department of Agri-

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[3]County Agricultural Agent, Manatee County, Florida.

culture has completed some extensive investigations and has summed up his results in U. S. D. A. Bulletin No. 1118. The disease is treated in a complete manner giving distribution, economic importance and seasonal occurrence. Winston recommends bordeaux spray as an effective means of control. The spray necessarily must be applied early and at definite periods as the fruit and leaves appear to become immune to the disease at an early stage of their development. Experiments on the control of this disease in the nursery are also being conducted at Gainesville by Mr. Jeff Chaffin of the State Plant Board.

A publication, Press Bulletin No. 342 by Dr. O. F. Burger and Mr. E. F. DeBusk, deals with another citrus disease commonly known as Green Spotting. This condition of the fruits is very conspicuous. There occur numerous, more or less irregular, green spots on the skin of mature, well colored fruit. This green spotting is caused by bruising the fruit so that the oil cells in the skin are ruptured. The oil permeates the surrounding tissue preventing it from becoming colored. It is shown that the cause of the disease is purely mechanical, and can be controlled by more careful handling of the fruit.

Dampoff, a disease caused by *Rhizoctonia* sp., has caused considerable trouble in citrus seed-beds. The fungus attacks the young seedlings at the surface of the soil girdling them and causing them to wilt and die. The organism has been isolated but not determined. Subirrigation is recommended along with frequent working of the soil immediately around the stems of the plants.

Cantaloupes have been dusted with copperlime dust and sprayed with bordeaux mixture to control both Downy Mildew *(Pseudoperonospora cubensis* (B. & C.) Rost.) and Anthracnose *(Colletotrichum lagenarium* (Pers.) Ell. & Hals.). Both fungicides gave considerable control. The treated fields showed up much better than the untreated fields both as to the length of life and the yield of the plants. There was very little difference in the control obtained from the dust or spray except that the sprayed plants looked a little better than the dusted ones.

The most recent disease of celery in the state is pink root apparently caused by *Fusarium* sp. This condition was reported from Manatee County where it was causing some trouble in several fields. Mr. Briggs, County Agent, has tried some experiments to control the disease in which he applied different amounts of sulphur and lime to the soil.

Blackheart still remains in the first rank as a destructive disease of celery. It was of serious consequence during the past year. Experimental work is being conducted again this year in an endeavor to determine the cause. Apparently fungi and insects have been eliminated as causal agents, altho both are generally present. Investigators believe it is the result of some peculiar physiological condition existing in the soil. Extensive experimental work was conducted by Mr. A. C. Foster of the United States Department of Agriculture at Sanford last year and as a result several possible causes of the disease have been proven negligible factors. The work during the coming season will be conducted on a more extensive scale. We are hoping for an early solution of the problem and the development of a method of control.

Early Blight *(Cercospora apii* Fr.) of celery is common wherever celery is grown in Florida. It has been very destructive in the past until liquid bordeaux mixture became generally used. At present this fungicide is giving good control of the disease. The plants are sprayed soon after they are up in the seed-bed and the spraying is continued thruout the growing season. During the past year experimental work was conducted at Sanford by Mr. Foster to determine if possible the relative values of copperlime dust and liquid bordeaux mixture in controlling this disease. Accurate account was kept of the amount of dust and spray used, the number of applications of each necessary to control the disease and the control obtained from applications made at different times of day. Briefly summarized, it was found that the dust applied in the morning when dew was present gave better control than when it was applied to dry plants in the middle of the day. The liquid spray proved to be better than dust in all cases except where such large amounts of dust were applied as to make the cost, from a commercial standpoint, prohibitive. Early blight as a disease is at present considered less of a problem to the celery growers than some other celery troubles.

During the past year or two the Plant Pathologist has received numerous inquiries concerning a wilt of palms accompanied by diseased specimens of affected plants. The cocoanut *(Cocos nucifera)*, Plumy coconut *(Cocos plumosa)* and Fan palm *(Washingtonia robusta)* have been most commonly attacked. The symptoms, in most instances, have been practically the same. The leaves become yellow and wilt one after another until the bud falls from the top of the plant. The disease is apparently caused

by *Pythium* sp. This fungus has been obtained most consistently in isolation cultures.

Up to the present time investigational work on cotton diseases has not been undertaken. Appropriation by the recent legislature has made it possible to start these investigations. Dr. A. F. Camp has been secured to undertake this much needed work and at the present time is becoming acquainted with the parts of the state where cotton is grown. Dr. Camp will probably do the major part of his work during the coming year on cotton wilt (*Fusarium vasinfectum* Atk.)

The most common and most destructive disease of cucumbers in the state is Downy Mildew (*Pseudoperonospora cubensis* (B. & C.) Rostow). This disease made very serious inroads into the industry during the past year causing fifty to seventy percent loss of the crop. Preliminary experiments were conducted thruout the past season and were successful to a considerable degree. Liquid bordeaux was applied in certain districts with practically no favorable results. In other sections the spray was a decided success. The past season was peculiar, inasmuch as the growing months were very wet and rainy. Such conditions are exceptionally favorable for the development of the fungus and at the same time very unfavorable for the best effect of the fungicide. In the vicinity of Williston the spraying experiments showed that a single application of bordeaux made the difference between a total loss of the crop and a crop that netted a profit. These experimental plots have proven to the growers in that section that bordeaux carefully made and applied will insure them a crop. Practically all cucumber growers in that section intend to spray during the coming season.

Experiments with bordeaux also showed that angular leaf spot and cucumber rot (*Bacterium lachrymans* E. F. S. & Bryan) were also practically controlled in the field. In one field four check rows were left unsprayed while the rest was sprayed twice with bordeaux mixture. The check rows were so badly attacked by the disease that the picking of marketable fruit averaged less than five hampers per acre while the sprayed plants averaged more than fifty hampers per acre.

The problem of developing an eggplant which is resistant to the organism causing Leaf Spot and Fruit Rot (*Phomopsis vexans* Sacc. & Syd.) is being carried on another season by Mr. Foster at Sanford. Previous to this time experimental work on this problem had been conducted during two seasons. The common

commercial plant which is susceptible to this disease was crossed with the native wild plant which is immune or free from the disease. The plants resulting from the "crossing" and by selection were found to possess resistant qualities and it is hoped that by continued experimentation a resistant or immune variety may be developed.

Soon after the fruit of the fig tree begins to ripen the leaves are attacked by two fungous diseases, namely Rust *(Physopella ficus* (Cast.) Arth.) and Leaf Blight *(Rhizoctonia microsclerotia* Matz). Several trees on the Experiment Station grounds have been very seriously attacked during the past seasons by these fungi and as a result were defoliated in July. As a result of the successive occurrence of these diseases the trees have been almost killed. Half of these trees were sprayed with 5-5-50 bordeaux mixture and half of them were left as checks. Two applications were put on the trees in May, 1923, with an interval of two weeks. Another spraying was contemplated but not applied because considerable fruit was set and the market value would be reduced by staining. The spraying proved very beneficial inasmuch as the Leaf Blight disease was completely controlled on the sprayed trees while the check trees showed 20-40% of the leaves attacked and shed by July 15th. The spraying also practically controlled the rust. The check trees were completely defoliated by August 1st while the sprayed trees were not defoliated until October 15th. The second crop of leaves on the check trees was attacked by the rust and was shed with the first crop of leaves of the sprayed trees.

The grape industry has become important during the past few years and consequently the attention of the pathologist has been called to numerous diseases prevalent on these plants. Bordeaux mixture has proven to be the best fungicide. Experiments conducted by Professor E. L. Lord* showed that bordeaux was superior to copperlime dust in the control of both Black rot *(Guignardia bidwelli* (Ellis) V. & R.) and Downy Mildew *(Plasmopara viticola* (B. & C.) B. & T.) There was also found considerable difference in varieties as to their susceptibility to Downy Mildew in the Experiment Station vineyard.

A variety plot of oats was planted on the Experiment Station grounds for the purpose of making selections of the best varieties to be propagated in Florida. When the plants were about six

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weeks old they were attacked by Crown rust *(Puccinia coronata* Cda.), and as the season advanced the disease spread and became worse. About thirty species and varieties were planted. Of this number about eight showed such resistance to the disease that they headed out. The others were either killed or weakened to such an extent that they could not head. Three of the eight varieties that headed showed considerable resistance. Selections were made and the seed will be planted for further selections.

In the vicinity of Micanopy, English peas were dusted with flowers of sulphur in an endeavor to control the Powdery Mildew *(Erysiphe polygoni* DC.) Two applications were made with a ten day interval. There were some indications of slight control after the third week. At this time the February freeze cut them to the ground.

The experimental work conducted during the past season on Irish potatoes is summed up in an Experiment Station Bulletin which will be ready for distribution soon after December 1. This work deals mostly with spraying and dusting in an attempt to control Late Blight *(Phytophthora infestans* (Mont.) de By.), which is the most serious potato disease in Florida. Other diseases found during a careful survey in Florida are mentioned in this bulletin along with a description, control methods and numerous pictures of diseased plants.

The necessity for investigational work became so acute during the past season that Dr. L. O. Gratz, recently from Cornell University, has been employed as Assistant Plant Pathologist to give his full time to the investigation of the diseases of Irish potatoes. He will be stationed at Hastings where he will be in charge of a fully equipped laboratory and also have access to extensive field plots.

Sweet potato fields have been inspected during the past two seasons and occasionally plants are found that show a crinkling of the leaves and a definite dwarfing of the runners. The plants thus affected develop practically no tubers, at least none that are marketable. One field near Gainesville showed 6% of the plants affected with the disease. The nature of the disease is very similar to common mosaic diseases of other plants. Inoculation experiments were all negative, indicating that the disease was not spread in this way. Tubers grown on diseased plants were planted and the draws secured for trials in the field. None of the plants grown from these tubers showed any symptom of the disease, except when very young.

The western part of Florida is still the center of the sugar cane mosaic infection. Very little change has been noted recently. The State Plant Board is directing the growing of a variety of Japanese sugar cane, "Cayana 10", which is immune to the mosaic disease. This variety has been grown and propagated for several seasons in Florida and has remained disease free when grown in diseased fields in the western part of the state. There will be a limited amount of this immune cane for distribution for seed purposes during the present season. It will be sent out thru the county agents and the growers receiving it will be pledged to grow it for seed purposes for a certain period. At the present rate of progress, this disease will be eliminated from the state in a few years.

The tobacco growers in the vicinity of Quincy have been supplied with a fine new building and a spacious greenhouse where Dr. W. B. Tisdale has been investigating the diseases of tobacco. In a recent bulletin, Agricultural Experiment Station Bulletin No. 166, on the diseases of tobacco, will be found data concerning "Black shank" *(Phytophthora nicotianae* de Hoon), a serious disease recently found in Florida. Selections have been made in an attempt to secure plants resistant to this disease. The first year's selections stood up well when grown on "sick soil", while the common susceptible types were all killed before they were a third grown. The work has increased so extensively during the past year that a full time assistant has recently been employed at the station at Quincy.

The investigational work on tomato diseases has been somewhat neglected during the past few years. Last season some attempts were made to control "Nail Head Rust" *(Macrosporium solani* E. & M.) by the application of both liquid sprays and copperlime dust. The season, however, was very adverse for the best results. Spraying with bordeaux practically controlled the disease in certain isolated places along the east coast, while at other places it was apparently useless. Copperlime dust was apparently ineffective. Experiments conducted at the Experiment Station showed that the disease could be very markedly controlled with two applications of 4-4-50 bordeaux mixture. More extensive work is planned for the coming season on the control of this disease.

During the past year the Plant Pathologist was called to St. Petersburg where a lumber company reported the loss of thousands of dollars worth of lumber because of a fungous organism

which causes timber to rot. The fungus *(Poria incrassata)* was found very prevalent in all parts of the large shed where it was destroying sawed boards, flooring, piles, joists, window-frames and building paper. To control this disease it was necessary to resaw all the lumber, put in a new concrete floor and thoroly disinfect the entire establishment.

During the past year a series of experiments was conducted in which many of the common garden seeds were treated with corrosive sublimate in order to determine the best way and the right time to treat seeds with this poison to insure good germinations and at the same time kill the disease causing the fungi which may be on them.

FIELD WORK, FOR THE YEAR, IN FLORIDA ON INSECT CONTROL

By Ed L. Ayers*

Due to the mild winter of 1922-23 and to an early beginning of the summer rainy season, this past season has been unusually favorable for the development of insect pests. Practically no crop has escaped without some damage, and there are instances where the damage to single crops in local areas has been appalling. An outstanding example of this was the outbreak of the celery leaf-tyer *(Phlyctaenia ferrugalis* Hbn.) in the Sanford area this spring, where the loss ran into the thousands of dollars.

Coincident with increased insect ravages there has been an awakening on the part of the growers to the necessity for insect control and better spraying methods. They have bought numerous new and more powerful spraying machines, and have sought information as to the kinds of sprays to use and how they can best be applied.

Average spraying operations are far from being efficient, and the problem of increasing efficiency is one of the most important steps in popularizing the use of sprays in insect control. Some of the most common errors are: The use of improper spraying mixtures, the use of poorly mixed spraying solutions, lack of pressure, the use of nozzles improperly set and handled in such a way that they do not cover all parts of the plant, and the use

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of nozzles with openings so large that the spraying solution comes out in a coarse stream instead of a fine mist.

The past year has witnessed the use of more dust in the control of insects than ever before. While dust is not in all instances to be relied on, there are many instances where it has greatly increased the rapidity and convenience of insect control, if not the efficiency. A particular example of this is the treatment of the rust mite and red spider of citrus trees with sulphur dust instead of by spraying with lime sulphur as in previous years. One can now by the aid of a power duster treat in two days an entire grove that formerly would have required two weeks or more to spray.

Rootknot

While the NEMATODE *(Heterodera radicicola* Greef) which causes rootknot cannot be classed as an insect, it is usually considered a problem for the entomologist, and no discussion of plant parasitism would be complete without mention of this pest. It is found on a wide range of plants, including all of our important horticultural crops with a few exceptions. Figs are probably the worst affected of any of our tree fruits, followed closely by peaches. The former cannot be grown except on heavy clay subsoils or in situations that are unusually wet or where the soil is well packed. The fact that an individual fig tree will do well around the house when others will not do as well further away, is due to the large number of roots that run under the house where there is more moisture and are therefore less subject to nematode injury. Peaches will not grow to any extent on average Florida sandy soils where this pest is present, except on plum roots.

In the trucking areas there have been many records of complete failure this season because of nematode infestation.

Professor J. R. Watson, Entomologist for the Florida Agricultural Experiment Station, has for a number of years been successfully treating seed beds and small areas by what is known as the sodium cyanide method. This treatment was applied to two acres of celery beds near Sanford this season with the usual good results.

Another series of beds, covering one-half acre, was treated with calcium cyanide instead of sodium cyanide, but the experiment was poorly handled and the results cannot be considered as final.

Mr. R. L. Trigg, who has been working under Professor Watson on the use of sulphur for the control of rootknot, has obtained some very interesting results, but the acidity of the soil was greatly increased, and further experiments will have to be made before anything of a definite nature can be published along this line.

Recommendations for Rootknot Control*

1. For the general farmer and trucker with plenty of land; the cheapest method of treating nematode-infested land is to grow immune or resistant crops on it for a period of three years.
2. For truckers with limited acreage, who cannot spare the land long enough for the starvation method (1), the number of nematodes can be greatly reduced by:
   a. Growing during the summer resistant or immune cover-crops in rows which can be constantly cultivated; or
   b. Summer fallowing, if loss of soil fertility is of minor importance; or
   c. Applying fresh cyanamid at the rate of a ton to the acre a month or two before the land is planted; or
   d. Flooding the land with water for a week or two.
3. For seed beds:
   a. Plant on newly cleared land; or
   b. Treat the land with sodium cyanide, dissolved in water, at the rate of 600 to 800 pounds to the acre. After this irrigate thoroughly. Next apply 900 to 1200 pounds of ammonia sulphate, which has also been dissolved in water, per acre, and irrigate again thoroughly. This is too expensive for a large acreage.

To Hinder the Spread of Nematodes

Be sure that the seed bed is free from nematodes by using new ground each year.

Do not set out, in nematode-free land, plants from a seed bed showing any trace of nematodes.

Thoroughly clean all dirt from plows and other tools before taking them into nematode-free fields.

Do not allow water to wash soil from an infested field over an uninfested one.

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*By courtesy of J. R. Watson, Entomologist, Florida Agricultural Experiment Station.

Citrus Insects

This season has not been an unusual one for citrus insects and mites. The early beginning of the rainy season, which was favorable to the development of entomogenous fungi, helped to a great extent in holding the scales, whitefly, etc., to a minimum.

The Purple Scale *(Lepidosaphes beckii* (Newm.)) and the Florida Red Scale *(Chrysomphalus aonidum* (Linn.)) are always important factors in lowering the vitality of the trees. Where careful fall and winter cleanup sprays were used the first named was not a serious factor this year. The latter has greatly increased in some sections of the state, indicating the necessity for more frequent and more thorough spraying.

The Rust Mite *(Eriophyes oleivorus* Ash.) has probably been held in check more than ever before because of the increased use of power dusters and sulphur, and the percentage of russeted fruit from this cause will, apparently, be greatly reduced this shipping season.

The Mealybugs (Dactylopiinae) have been unusually severe this season in most sections of the state. The Common Mealybug *(Pseudococcus citri* (Risso)) affects citrus and considerable damage has been occasioned by this insect in citrus plantings in practically all sections.

The ordinary method of treating scales with oil emulsion spray has not proven very effective, but a solution of nicotine sulphate, as follows,

Nicotine sulphate, 40%	1 pint
Fish oil soap	10 lbs.
Water	100 gals.

proved quite effective, as did also lime sulphur solution, diluted at the rate of one gallon to 70 gallons of water. High pressure spraying is also necessary for successful mealybug control. If possible, the pressure should be not less than 250 pounds. The gradual increase of natural parasites, particularly the scale-eating caterpillar *(Lactilia coccidivora* Comst.) and the fungus *Entomophora fumosa* Speare were important factors in the final bringing of this pest under control.

Deciduous Fruits

The situation with respect to insects of deciduous fruits is approximately the same as it has been for the past several years. Insects and diseases continue to be important limiting factors

in production. In addition to the nematode, which has already been mentioned, the San Jose scale *(Aspidiotus perniciosus* Comst.) has taken heavy toll of all varieties of deciduous fruit trees, and it has been closely rivaled, if not surpassed, in destruction of peach trees by the peach tree borer *(Sanninoidea exitiosa* Say). The plum curculio *(Conotrachelus nenuphar* (Hbst.)) has greatly lowered both the yield and the quality of peaches and plums, due to both its feeding on the fruit and the fact that the female deposits her eggs in the fruit as soon as it forms. The hatching egg results in the "wormy" fruit which is all too common in this state.

The Plum Gouger *(Coccotorus scutellaris* Lee) closely resembles the curculio and the damage wrought by the gouger is often mistaken for that of the curculio.

*Spray Schedule for Peaches**

No.	Enemy	Materials	Time of Application	Remarks
1	San Jose Scale	Commercial lime sulphur, 1-8	When trees are dormant, Dec. or Jan.	Must not be used after buds have started.
2	Curculio and gouger	Lead arsenate 1 lb. to 50 gal. water, plus 5 lbs. lime	Just after petals have fallen	Use good rock lime and slack before using.
3	Curculio and gouger	Repeat No. 2	10 days later	
4	Brown rot, scab, curculio and gouger	Self-boiled lime-sulphur 8-8-50, plus 1 lb. lead arsenate	2 weeks after No. 3	If curculio is not present omit the lead arsenate.
5	Brown rot	Self-boiled lime-sulphur 8-8-50	About 4 weeks before fruit ripens	If curculio is present and lead arsenate was not used in No. 4, it may be added here.

*Prepared by O. F. Burger, Plant Pathologist, and J. R. Watson, Entomologist, Florida Agricultural Experiment Station.

Peach Tree Borer

Treatment should be given around the first of November. Remove all weeds, grass and other obstructions from around the base of the tree for a distance of two feet. Thoroughly pulverize and smooth the soil. Place a 1½ inch band, using 1 ounce Paradichlorobenzene 1½ inches from the tree. Cover carefully with a 2 to 4 inch mound of pulverized soil and pack firmly. Where the borers are above the ground the trees should be mounded to the level of the highest borer before the band of Paradichlorobenzene is applied. Trees under two years old should not be treated and care should be used to remove the mounds from trees under six years of age after one month from application.

TRUCK CROP INSECTS

The year has been an unusual one for the insects affecting truck crops and the loss therefrom has amounted to many thousands of dollars. There are few crops which have entirely escaped damage, but some crops have received unusually severe injury.

Celery

There have been two outstanding insects of celery, the celery leaf-tyer *(Phlyctoenia ferrugalis* Hbn.) and the garden flea hopper *(Halticus citri* (Ash.)). The celery leaf-tyer has caused considerably more loss than has the garden flea hopper, but the latter is present every year and does some damage to all stages of the plants, beginning in the seed bed and continuing on through until harvest.

Two methods of control for the celery leaf-tyer were tried out by the growers; first, spraying with arsenate of lead, second, the trapping of the moths. Spraying did not prove effective, due to low pressure spraying machines and the fact that spraying was begun too late. The eggs are laid on the outside leaves, where the young worms feed for a short while before starting downward into the heart of the bunch, where they web up and are protected from the spraying solutions. The adult of this pest is a small moth, and the growers were quite successful in trapping large numbers of them by means of bright lights placed over shallow pans containing kerosene. In a count of these made by A. H. Beyer, Assistant Entomologist, at the Florida Agricultural Experiment Station, it was found that more than 50% of the moths were females, but no observations were made as to whether they were old and past the egg-laying stage, as is often the case, or whether they still contained large numbers of eggs.

An effort was made, with some success, to induce spraying with arsenate of lead under high pressure, and to have spraying begun when the caterpillars were first hatched.

The garden flea hopper cannot be reached by means of the common spraying solutions. Probably the most effective spray is kerosene emulsion, made as follows: 1½ lbs. of soap dissolved in 3 gallons of hot water; add 3 gallons of kerosene and mix to a creamy mass by means of a pump. Add this to enough hot water to make 50 gallons of the solution.

Under the direction of Professor Watson some extensive experiments in dusting for this pest were made, using a new dust of calcium cyanide. A hand duster was first used, but later a

power duster. With the former there was something like 30% to 40%, and with the latter 70% to 80% control. The celery was examined one week after the application of the calcium cyanide dust and found to retain traces of the cyanide. The fact that cyanide is highly poisonous makes it necessary to determine the length of time it remains on the plant after application, in order that the celery will not be dangerous for human consumption.

Beans

The Bean Leaf-hopper *(Empoasca mali* (LeB.)) has stood at the head of the list of bean insects for a number of years. This has been particularly true with reference to fall beans. Its habit of hopping away when sprays are being applied has made it extremely difficult to control. It has been found* that a 4-4-50 solution of bordeaux mixture to which has been added ½ pint of 40% nicotine sulphate, is very effective in the control of this pest if applied from above and from both sides of the row at the same time, under high pressure, provided it is enclosed under a hood of either cloth or tin.

The Florida Flower Thrips *(Frankliniella tritici bispinosa* (Morgan)) also did serious damage to several acres of beans in Alachua County. This was one of the most serious infestations of thrips ever reported on beans. The outbreak was readily brought under control with the nicotine sulphate and soap formula given before under the heading of Citrus Insects.

Melons

The Melon Aphis *(Aphis gossypii* Glover) has been unusually prevalent this spring and the chief difficulty has been in getting the growers to start spraying or dusting early enough for successful control. They wait until it is entirely too late before beginning and then fail to reach the under side of the leaves, which should be their chief objective. Dusting with a good quality of nicotine dust has proven to be very effective, in some instances, in the treatment of this pest, but it has not proven to be as satisfactory as spraying with the nicotine sulphate solution commonly recommended. Most of the treatment has been in the form of nicotine sulphate incorporated with bordeaux mixture which is used for the control of Anthracnose (caused by the fungus *Colletotrichum lagenarium* (Pers.) Ell. & Hals.) and other diseases.

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*Florida Experiment Station Bulletin No. 164, A. H. Beyer.

Miscellaneous Insects

There have been numerous and unusual outbreaks of insects, the seriousness of which had never been reported before. Some of the most interesting observations made were on the damage of the Florida flower thrips. In addition to the severe attack on the foliage of the bean it has also, in some instances, totally destroyed entire fields of young cotton and squashes because of heavy feeding on the foliage. By injury to the berries the flower thrips has destroyed the entire crop of blackberries and strawberries in some localities.

A SPRAY SCHEDULE FOR PECANS

(There is here published a spray schedule for pecans. This schedule it is believed will be welcomed by the Florida pecan growers, who should find the information contained of great practical value. The preparation of this schedule is the work of Mr. G. H. Blackmon, Pecan Culturist of the Florida Agricultural Experiment Station. In its preparation Mr. Blackmon has had the assistance of his co-laborers at the Station, Doctor O. F. Burger, Plant Pathologist, Professor J. R. Watson, Entomologist, and Mr. A. H. Beyer, Assistant Entomologist.—Editor.)

No.	Enemy	Material	Time of Application	Remarks
1	Little May-Beetle	1½ lbs. powdered lead arsenate, 3 lbs. slacked lime, 50 gallons water	As leaves are unfolding	Particularly serious in West Florida.
2	Nut Case Bearer	Same as 1	Shortly after nuts have set, about the size of garden peas. This will be about May 12, but will vary with the seasons (2) 7-10 days after first. (3) 4 or 5 wks. after 2d.	The 2d and 3d application may be made by putting the lead arsenate in 4-4-50 Bordeaux in spraying to control scab. It is very important that the work be thoro. Use a straight nozzle and high pressure.
3	Leaf Case-Bearer	Same as 1	Aug. 1-Sept. 15	It is best not to delay the spraying too late in the fall, as some of the larvae will seek hibernation quarters towards the last of September.
4	Fall Web-Worm	Same as 1	Same as 3	Will be controlled in spraying for leaf case-bearer. If webs are scattered they may be destroyed by burning or removed with long handled pruner.
5	Walnut or Pecan Defoliator	Same as 1	Same as 3	See remarks under No. 4. When colonies are not so numerous they should be destroyed by crushing or other practicable means.
6	Pecan Shuck-Worm	Not practicable to spray		Can reduce infestation by gathering and destroying all shucks after harvest.
7	Pecan Weevil	1 oz. carbon disulphide to each bushel of nuts		Fumigate for 24-48 hours in a tight box with a tight fitting lid. Not necessary to limit time unless nuts are to be planted.

No.	Enemy	Material	Time of Application	Remarks
8	Scale and Spittle Insect	6 gals. lime sulphur, 50 gals. water	During Jan. and Feb. while trees are thoroly dormant	This dilution cannot be used after buds have forced out.
9	Pecan Cigar Case-Bearer	Same as 1	In spring when insects appear	This insect is usually of minor importance but should it occur in large numbers it can be controlled as indicated.
10	Pecan Bud-Moth	Same as 1	During the spring beginning as leaves unfold	Very difficult to control. Spraying as indicated will help hold insects in check. Keep trees thrifty and in a good, vigroous growing condition.
11	Flat-headed Borer			Worming and using the trap-log. See Farmers' Bulletin 843. Washes are often recommended but the results are doubtful.
12	Round-headed Borer			Push into hole, cotton saturated with carbon bisulphide. Plug with wax.
13	Hickory Twig-Girdler			Gather the fallen branches in the fall and winter and burn them.
14	Scab	4-4-50 Bordeaux mixture	Keep nuts completely covered from time they are formed until matured. This will require four or more applications, depending on the rain fall.	A high pressure is required and in orchards containing trees 40 ft. high and over, it will be necessary to use a sprayer with 7 or 8 horse power motor.
15	Nursery Blight	Same as 14	From 3-5 applications, depending on rain fall, beginning about April 15-May 1.	Keep foliage covered with the fungicide to prevent the disease. Keep nursery trees thrifty, and in a vigorous growing condition.
16	Brown Leaf-spot	Same as 14	July 1, 24, and Aug. 20	Usually three applications will prevent the disease occurring. If trees are kept in a vigorous thrifty condition the fungus is seldom serious.
17	Mistletoe			Remove completely by cutting out entirely the roots. If possible remove the branch or twig on which the mistletoe is growing.

ROSETTE: There are those diseases in pecans that cannot be controlled by spraying, and this is one of them. All of the evidence that has been collected by investigators points very conclusively to rosette as a sign of the soil being deficient in humus, fertility and moisture supply, or a soil that is not suited to pecan growth, such as high water-table, hard-pan, etc. If the soil does not have either one of the last two, the treatment of a rosetted orchard should be one that will replenish the elements lacking. Prune out all of the rosetted branches and destroy them by burning. Make heavy applications of barnyard manure, and grow and turn under rank-growing cover crops such as velvet beans

for the summer and oats or rye for the winter. Always keep the trees in a thrifty, vigorous growing condition.

KERNEL SPOT is caused by the puncture of the Pumpkin Bug. Cowpeas, beggarweed and soy beans are favored food plants on which the bugs feed. It is therefore not advisable to use these as cover crops in the pecan orchard. Velvet beans are good as a cover crop and are comparatively free from Pumpkin Bugs.

The following bulletins on insects and diseases of the pecan may be had by writing to the address given, for them:

Fla. Agri. Exp. Station, Gainesville, Florida.
Bulletin 147, Press Bulletin 319.
U. S. Dept. of Agriculture, Washington, D. C.
Bulletin 756, "Pecan Rosette in Relation to Soil Deficiencies," S. M. McMurran.
Bulletin 1102, "Kernel Spot of the Pecan and Its Cause," J. B. Demaree.
U. S. Dept. of Agri. Farmers' Bulletins, Washington, D. C.
843, "Important Pecan Insects and Their Control," by John B. Gill.
995, "Wood Rot in Pecan Trees," S. M. McMurran.
1129, "Diseases of Southern Pecans," S. M. McMurran and J. B. Demaree.

THE PECAN AND PERSIMMON BORER

By J. R. WATSON

There are two borers that commonly attack pecans and persimmons, including the Japanese variety. One of these is a caterpillar, that is, the larva of a moth. This makes a hole somewhat smaller than a lead pencil directly in the center of the tree in which it works up and down.

The best method of controlling this borer is to shove into the hole a little wad of cotton which has been saturated with carbon bisulphide. The hole at once should be stopped up with wax, putty or paraffin.

The other borer is the larva of a beetle and is commonly called the "flat-headed apple tree borer." It works just beneath the cambium layer and will frequently girdle a young tree and kill it. This borer seldom works in perfectly healthy trees as the sap coming out from the wound would drown the borer or cause it to retreat, but in trees that are not perfectly vigorous, and therefore, somewhat dry, the borer can work to advantage and frequently kill a tree. It is, therefore, important to keep the trees in a vigorous growing condition. All cuts caused by pruning should be trimmed close and painted with white lead paint.

The borer is particularly injurious to newly transplanted trees.

The eggs are laid by a metal gray colored beetle about ½ inch long and always on the sunny side of the tree. A board set up in front of a tree trunk will often prevent the injury or the trunk may be wrapped with burlap or paper. A sun-scald injury to the bark is always a favorite place in which to lay the eggs.

These borers should be cut out of infested trees with a sharp knife taking pains not to injure the bark more than is necessary. The beetles emerge especially in the early spring and one can use a trap to attract them. For this purpose oak, pecan, or hickory logs are the best. These should be placed in an orchard in the early spring and burned before the following winter. This burning is absolutely necessary in order to prevent a new crop of beetles issuing from the log. The grubs will not be able to crawl from the log to the tree, but must spend their entire time in the log on which the eggs are laid.

STATISTICS ON THE CITRUS PLANTINGS IN FLORIDA

By Frank Stirling

A second inspection of all the citrus plantings in Florida has just been completed. This work was done in connection with the work of eradicating citrus canker in the state. Employees of the State Plant Board and of the Bureau of Plant Industry, U. S. D. A. have made careful records of each variety and the number of citrus trees contained in each and every planting inspected. In the attempt to learn if there were any centers of canker infection rapid inspections, known as "scout inspections", have been made in all sections of the state. This second survey of the entire state has just been completed after something like two years of work.

The records made in connection with these inspections constitute the most complete and accurate statistical material of this nature available. It has been the effort of the inspectors to not only see every citrus tree in Florida but at the same time to make a record of it. The number of citrus trees in each county and in the state as a whole has been compiled from the inspection reports on the 30,462 properties inspected since early in the spring of 1922.

The total number of citrus trees in grove formation is found to be 16,677,227. The number of acres is arrived at by assuming there are 70 trees to the acre in most sections of the state. How-

CITRUS PLANTINGS IN FLORIDA

STATISTICS COMPILED BY STATE PLANT BOARD IN ACTUAL INSPECTIONS OF CITRUS TREES (TO DECEMBER 31, 1923)

County	Properties	Orange Trees	Grapefruit Trees	Tangerine Trees	Lime Trees	Lemon Trees	Kumquat Trees	Total Trees	Acres
Alachua	1,005	69,803	4,538	4,918	14	229	320	79,822	1,126
Baker	53	1,435	21	0	0	8	783	2,247	32
Bay	88	14,723	460	14	6	25	143	15,371	219
Bradford	26	1,275	39	3	0	4	0	1,321	19
Brevard	2,607	494,991	143,340	11,565	255	383	720	651,254	9,303
Broward	292	37,025	56,467	547	4,724	4,171	184	103,118	1,459
Calhoun	53	8,756	635	227	0	10	86	9,714	140
Charlotte	178	15,675	6,581	1,962	0	35	0	24,253	346
Citrus	44	17,205	935	100	0	0	0	18,240	260
Clay	334	10,072	591	148	51	158	264	11,284	161
Columbia	109	1,529	97	4	0	10	15	1,655	23
Dade	2,155	222,347	757,522	36,509	33,569	26,700	2,126	1,078,773	15,412
DeSoto	528	370,159	105,406	22,754	756	187	8	499,270	7,132
Dixie	1	123	39	0	0	0	0	162	2
Duval	154	15,319	1,695	60	0	1	116	17,191	246
Escambia	254	46,785	352	9	3	67	179	47,395	676
Flagler	50	16,247	740	95	10	0	0	17,092	244
Franklin	9	221	5	0	0	0	0	226	3
Gadsden	24	155	10	2	0	0	37	204	3
Glades	44	3,850	4,569	1	39	59	0	8,518	121
Hamilton	22	91	30	0	0	4	6	131	2
Hardee	659	362,006	39,599	11,687	24	175	843	414,334	5,919
Hernando	218	55,457	29,918	17,515	100	0	0	102,990	1,471
Highlands	720	288,784	232,649	18,809	7,851	2,429	781	551,303	7,876
Hillsboro	1,579	608,958	122,479	8,376	447	1,575	179	742,014	10,600
Holmes	33	1,171	1	0	0	1	5	1,178	17
Jackson	75	24,102	50	4	0	12	49	24,217	346
Jefferson	82	2,326	294	0	0	7	164	2,791	40
Lafayette	33	327	19	1	0	0	9	356	5
Lake	1,675	940,590	306,026	68,286	799	1,995	484	1,318,180	18,831
Lee	1,913	300,413	276,897	28,717	836	680	1,070	608,613	8,695
Leon	61	1,396	689	0	502	4	303	2,894	41
Levy	437	7,116	172	116	28	78	1	7,511	107
Liberty	36	621	7	3	0	5	8	644	9
Madison	61	509	40	2	0	21	12	584	8
Manatee	448	194,218	262,548	4,715	1,108	649	50	463,288	6,620
Marion	1,226	347,946	59,639	18,346	155	315	280	426,681	6,095
Monroe	547	5,897	17,684	3,298	193,333	13,945	0	234,157	2,341
Nassau	46	762	17	0	0	5	6	790	11
Okaloosa	43	355	30	0	0	5	6	396	5
Okeechobee	142	27,299	4,182	469	461	2,251	2	34,664	695
Orange	1,672	1,268,789	223,151	53,280	1,441	473	367	1,547,501	22,107
Osceola	493	130,140	53,408	26,262	760	2,784	56	213,410	3,049
Palm Beach	988	114,102	119,517	5,675	12,531	16,853	848	269,526	3,850
Pasco	616	119,526	54,161	4,355	368	1,208	260	179,878	2,569
Pinellas	1,150	467,140	464,030	25,370	908	12,572	421	970,441	13,863
Polk	2,772	2,640,442	1,079,018	94,182	692	2,815	1,417	3,818,566	70,714
Putnam	877	242,390	40,356	37,370	934	209	246	321,505	4,593
St. Johns	290	33,078	3,206	924	1	195	281	37,685	538
St. Lucie	1,482	422,442	147,319	5,455	353	208	444	576,221	8,231
Santa Rosa	164	12,114	158	0	0	5	119	12,396	177
Sarasota	299	61,125	43,031	601	951	1,989	163	107,860	1,541
Seminole	514	322,161	30,509	21,947	21	77	73	374,788	5,354
Sumter	16	43,641	20,790	950	0	0	0	65,381	934
Suwanee	75	1,044	124	27	1	14	130	1,340	19
Taylor	56	731	19	1	0	18	8	777	11
Union	11	271	15	0	0	0	0	286	4
Volusia	791	510,866	64,544	73,369	366	303	358	649,806	9,283
Wakulla	22	214	47	0	0	8	1	270	4
Walton	93	3,827	61	77	0	80	65	4,110	59
Washington	17	634	20	0	0	0	0	654	9
Totals	30,462	10,912,716	4,780,496	609,107	264,398	96,014	14,496	16,677,227	253,570

ever, in Polk County the average number is 54 trees while in Monroe County lime trees are planted on an average of 100 trees per acre. Taking these factors into consideration there are ap-

proximately 253,570 acres planted to citrus of all varieties. The accompanying tabulation lists the six main varieties, namely: orange, grapefruit, tangerine, lime, lemon and kumquat. Satsumas are listed as oranges. Of this variety there have been planted something like eight thousand acres in the west Florida counties during the past two years.

Approximately 35 percent of all citrus plantings were made during the past four years and constitute those classed as "non-bearing" while the remaining 65 percent constitute those classed as "bearing", or over four years old. On this basis there are now planted in Florida 163,820 acres of bearing citrus trees and 88,749 acres of non-bearing age. The latter represent the increase in acreage.

MORE HASTE, LESS SPEED IN CULTURE OF GOLDEN FRUIT*

STATE PLANT BOARD OFFICIAL TELLS OF NECESSITY FOR CLEAN SATSUMA STOCK

BY F. M. O'BYRNE

If you received a telegram at eight o'clock some morning in Pensacola calling you to Jacksonville at once, would you take a freight train leaving Pensacola at ten o'clock or wait for the passenger train at 6:20 P. M.? You would wait for the passenger train, of course, for if you left on the freight the passenger train would pass you on the side track at River Junction about midnight, and beat you to Jacksonville by many hours. Yet there are many good people in Satsumaland who are taking the freight of "too much haste" instead of waiting for the speedy train of "proper methods".

EXAMPLE OF HASTE

As an example of such haste see the large number of people who are budding little trifoliata seedlings hardly larger than a match. They think they are gaining time by doing so. But are they? There must always be a balance between the top of a tree and its root system. You can't have a big top on a small root system. Is there anything about the budding process that stimulates the growth of the root system? Most decidedly no! The

*Reprint from Pensacola Journal, Dec. 10, 1923.

action is just the reverse. The cutting off of the top after budding is a shock to the seedling and it sets a small seedling, with a small root system, back farther than it does a good stocky one. As an example, let me cite a certain nursery of which I have personal knowledge. The seedlings were all the same age. Half of it was budded one fall and the other half the following budding period. At the planting time the trees that were budded last were far ahead of the others. More haste—less speed. You can fool yourself but you can't fool the plant.

Some people in their haste are going to plant dormant buds this winter. (This means trifoliata seedlings which have living Satsuma buds in them which haven't "sprung" yet.) Don't do it! Those dormant buds won't survive a very dry spring except at a tremendous cost for watering. Even with plenty of (costly) watering you may lose some and stunt many others if the spring is exceptionally dry. If you know some one who did it successfully, find out what kind of weather he had. If you are sure of having weather that is as good, suit yourself. Otherwise, better wait; it's safer!

Wouldn't Plant Dormant Buds

Even if one knew that the weather conditions were going to be ideal, he shouldn't plant dormant buds. Those buds aren't going to make a uniformly strong growth, whether in the nursery or in the field. Some will grow rapidly; some moderately; some will be little runts. That is true in the best of nurseries. Good nurserymen do not sell all the buds that grow. From fifteen to twenty-five percent turn out to be runts, and are thrown away. The balance are graded and sold by size. A grove will look much less ragged and will do better if you will plant all the trees in one grove of the same size. If you plant dormant buds you will inevitably have all sizes of trees planted indiscriminately and that grove will look uneven and ragged forever.

Then think of the foolishness of the matter from an economic standpoint. You can grow ten thousand Satsuma trees on an acre in nursery form; enough to plant one hundred to two hundred acres of grove depending on your planting distance. Which would you rather cultivate and care for, ten thousand trees on one acre or scattered over one hundred acres? It costs money to clear, fence, plow, take all the roots from, and cultivate one hundred acres of land for a year. If you can save that outlay of money for a year, you had better do it. If you have your land all

ready anyhow, better plant it to cowpeas or velvet beans and turn them under to improve the soil rather than to have the dormant Satsuma buds planted all over that one hundred acres. The trees will be far easier to look after and care for on the one acre and the ninety-nine acres with the cover crop on it can be more cheaply cared for than if it has trees planted all through it.

Couldn't Be Given Buds

The writer was in a nursery recently where they had budded match size trifoliata seedlings, and had some little Satsuma buds which had just sprung and were out but a couple of inches tall. He learned that the owners wanted one dollar each for the little things. He said then that he not only would not pay a dollar each for them, but would not accept them as a gift if it was stipulated that he must plant them in grove form at once. Those trees should be grown another year before being planted. The writer would much prefer to make a cash deposit now with a reliable nurseryman on an order for trees of a certain size and grade to be delivered next winter. Almost any good nursery will accept such an order for next winter's delivery. Don't pay exorbitant prices for poor stock to get started now when by waiting a year and planting with better trees purchased at reasonable prices you will have a bearing grove much earlier. There should be an abundant supply of trees for all practical purposes after this present planting season.

Must Keep Cost Down

As a good business man the grower must realize that to make his grove a financial success he must keep his costs down. To do this he must start with good stock, purchased at a reasonable price, plant it properly on well prepared soil and then cultivate it and fertilize it in such a way as to get maximum growth consistent with safety. He must avoid the pitfalls of poor or diseased planting stock, exorbitant prices, poorly prepared land, improper planting or cultural methods. As regards cultivation and fertilization, he must take a middle of the road course. He must not plant out his trees expecting that they will care for themselves. They won't do it! Better not plant a grove than plant it and then abandon it. The young trees must be cultivated regularly and fertilized. On the other hand, one must not over cultivate or over fertilize the grove. The Satsuma must be per-

fectly dormant during the winter. No fertilizing should be done after the middle of August and the last application should be lower in ammonia and higher in potash than the first two fertilizations. A young grove should be given at least three fertilizations a year; spring, summer and an August fertilization.

Hire Trained Men

Don't let untrained men plant your grove without supervision. Remember that citrus trees are often planted too low—never too high. They should be planted in the grove an inch or two higher than they stood in the nursery. It is a good idea to throw a couple of back furrows or a narrow bed and plant on top of that. Then plow to the trees leaving a furrow down the middle to drain off excess water during rainy periods. If the grove is on a hillside these ridges should run along the hill and not down it. This will prevent washing. Remember that citrus trees planted too low will never do well. Recently the writer visited a grove near Milton. Some of the trees were not doing well at all. On examination it was found that they were planted from a foot to eighteen inches too low. (Two inches too low would have been too much.) The grove manager explained that he didn't know any better, because they were the first trees that he had ever planted. The grove owner was at fault in turning as important a job as planting a grove over to an untrained man.

Buy your trees from a perfectly reliable nurseryman. There is as great a difference in trees as there is in soils. First, there are many kinds of Satsumas. Plant only the Owari. It is the only worthwhile Satsuma on the market today. There may be better ones coming, but it is the best that we know of now—the only proven success. We know of several inferior types. Plant only the Owari and as you will have to depend on the nurseryman's word as to the variety, buy from a man who is honest and who knows his business.

Have Certificate of Inspection

Make sure that there is a Florida certificate of inspection bearing your name and address attached to each bundle, box or other container of nursery stock that you buy. If you neglect this important point you may be buying from an uninspected nursery, or even worse, you may be getting part of a consignment of trees which have been smuggled in from outside the state and you may

get Japanese camphor scale, Argentine ant, or citrus canker—possibly all three. The man who deliberately buys trees that he knows have been smuggled in deserves all the trouble that he will probably get into. Like the man who buys bootleg liquor, no one can waste much sympathy on him in his misfortune, but unfortunately his trees constitute a menace to all surrounding groves and the burden may fall more heavily on his innocent neighbors than himself. A man who permits his neighbors to plant smuggled trees is taking fearful chances. Notify the State Plant Board, Gainesville, Florida, if you know of such. Perhaps this sounds like an alarmist's statement—but the most alarming rumors are in circulation about proposed smuggling of Satsumas from areas in the Gulf States where canker, Argentine ant and camphor scale are known to abound. Those who have groves already or are planting them now, are alive to the danger and purpose to cooperate with the Plant Board officials to put a stop to this very dangerous business.

Satsuma Shortage Blessing

Finally, let us record the fact that the present shortage of Satsumas is in some ways the biggest blessing that has ever happened to West Florida. Had there been an ample supply of trees on hand, West Florida would undoubtedly be overplanted right now. We don't mean over-production—there is not much danger of that. We mean many growers would have such large acreages planted that they couldn't care for them properly. A grove once stunted by lack of attention recovers very slowly—if ever. Many a grove of fifty or one hundred acres is a financial failure, and many a grove of ten or fifteen acres is making its owner well-to-do. Far better a ten acre grove well cared for, than a fifty acre grove poorly cared for. It makes no difference to the tree whether it is injured by lack of attention or by having the wrong things done to it, or even the right things done to it at the wrong time. So far as the grove is concerned the effect is much the same. The grove becomes stunted and is not the profitable money making proposition that you expect or that it might have been.

The growing of Satsumas holds a great promise for West Florida, but the groves should be developed with speed and not with haste. Nothing responds more quickly to care than a Satsuma grove. See that it gets it. Don't plant more than you can care for properly!

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*........*Editor*

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FOUR YEARS OF CITRUS PLANTINGS

At the close of each fiscal year the Nursery Inspector checks over the number of citrus trees moved during the year as recorded on the invoices filed in his office by nurserymen and others moving trees into and within the state. This information is valuable, as it serves as a barometer which shows the rate at which citrus and other developments are progressing. It also shows the trend of plantings and should serve as a guide to those planning new developments. The movement of budded citrus stock to Florida points during the past four years was as follows:

Variety	Year ending Apr. 30, 1920	Year ending Apr. 30, 1921	Year ending Apr. 30, 1922	Year ending Apr. 30, 1923
Orange	1,458,293	1,118,255	1,117,752	1,953,638
Grapefruit	460,614	352,522	259,416	504,250
Tangerines	133,639	121,662	171,750	437,259
Satsumas	50,715	41,627	140,378	80,009
Total Budded	2,103,261	1,700,064	1,689,296	2,795,756

Grand total for four years, 8,467,777.

The number of budded citrus trees planted in 1915-16 amounted to only 894,754. Approximately the same number were planted annually for the next three years, which were war years. With the close of the war developments long delayed were started and

were well under way in 1920. Then came the shortage in budding stock which caused the reductions in output in 1921 and 1922. This was due to the fact that practically no citrus seed was planted during the war period. During 1920 and 1921 budding stock and citrus stock seed rose to exorbitant prices. There is now an abundance of stock and should be in the future.

Points of interest to be noted in the above table are the sustained popularity of round oranges, the decreasing popularity of the pomelo and its sudden revival in 1923, due probably to the successful canning of grapefruit hearts.

Note the rise in popularity of the tangerine. There were but 11,976 tangerines moved in 1916 as compared with 473,259 in 1923. The crest is probably passed in tangerine planting.

The Satsuma situation is interesting. In 1920 there was no demand for Satsumas and a large nursery advertised Satsumas at bargain prices. These Satsumas had been grown under contract for a defunct Louisiana concern. All that could not be disposed of at cut prices were dug and burned at the end of the season. The number thus destroyed ran into the thousands. The following year saw the beginning of the Satsuma boom. It started feebly at first; the next year every Satsuma of planting size and some that were not large enough yet were sold and moved. In 1923 the supply did not equal one-fourth of the demand.

The output for 1924 will be double or treble that of 1923 and it will probably increase year by year if no calamity such as a severe freeze or the introduction of citrus canker intervenes.

In February, 1919, the Plant Board completed a grove to grove inspection of the entire state and the number of citrus trees in grove form at that time was given as 11,356,414. On another page in this issue of the Bulletin will be found a report on the second grove to grove inspection—just completed. It will be noted that at this time there are 16,677,227 grove trees in the state, an increase of 5,320,813 trees over the number reported in February, 1919.

It will be noted that during the same period the Florida nurseries delivered to Florida points 8,467,777 trees, or 3,146,964 more than the inspectors found in grove form. This apparent discrepancy can be accounted for when one considers that many trees are planted in unsuitable locations and die and that others are killed by neglect, adverse weather conditions, or are abandoned by the owners after they have been planted. As a result,

they were not alive when the inspectors came around. The only surprise to well informed growers will be that the discrepancy is not greater. That it is not is probably due to the fact that we have had no very cold weather during the past four years and because each year a larger percentage of trees are being planted by development companies which give their planting proper care.

QUARANTINE DEPARTMENT

Quarantine Inspector's Quarterly Summary for All Ports and Stations for Quarter Ending September 30, 1923

Ships and Vessels Inspected:			
From foreign ports	599		
From U. S. ports other than Florida	378		
From Florida ports	211		
Total		1,188	
Number of Parcels Inspected:			
Arriving by water:			
Passed	132,724		
Treated and passed	38,618		
Returned to shipper	219		
Contraband destroyed	380		
Total		171,941	
Arriving by land—express, freight, wagon, etc.:			
Passed	3,684		
Treated and passed	412		
Returned to shipper	99		
Contraband destroyed	290		
Total		4,487	
Arriving by mail:			
Passed	192		
Treated and passed	8		
Returned to shipper	6		
Contraband destroyed	3		
Total		209	
Grand Total of Parcels Inspected			176,637
Number of parcels on hand pending determination as to final disposition	11		

Principal Pests Intercepted During the Quarter Ending September 30, 1923

Insect	From	No. Shipments Intercepted
Blackfly *(Aleurocanthus woglumi* Ashby)	Cuba	1
Pseudaonidia paeoniae (Ckll.)	South Carolina	6
Rufous scale	Bahama Islands	7
Rufous scale	Cuba	1
Rufous scale	Mexico	1
Strawberry crown borer	Georgia	1
West Indian fruitfly *(Anastrepha fraterculus* Wied.)	Cuba	5
	Jamaica	1

Number Packages Fruits and Vegetables Fumigated at Florida Ports from July 1st to Sept. 30th, 1923

Key West	53,609 packages
Pt. Tampa	48.237 packages
Miami	6,383 packages
Total	108,229 packages

DEPARTMENT OF CITRUS CANKER ERADICATION

Report on Eradication Work in Cooperation With the Bureau of Plant Industry, U. S. Dept. of Agri., for Quarter Ending September 30, 1923

Citrus grove trees inspected	1,479,674
Citrus nursery trees inspected	35,008,173
Inspectors employed (entire Plant Board force)	92
Inspectors employed on canker eradication	32
New properties showing active infection	0
Total properties showing active infection	0
Grove trees found infected	0
Nursery trees found infected	0
Counties in which active infections were found	0

General Summary

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	15.150
Nursery trees found infected since May, 1914	342,260
Number properties infected to September 30, 1923	510
Properties declared no longer "Danger Centers"	486
Properties still classed as "Infected" Sept. 30, 1923	24

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to September 30, 1923:

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Jan.	....	306	86	14	0	0	0	0	0	1
Feb.	....	165	21	4	1	0	0	0	0	1
Mar.	....	444	49	9	1	1	0	0	0	2
Apr.	....	408	49	169	2	1	0	0	0	3
May	108	1042	338	52	1	1	0	0	585	2
Jun.	160	772	450	45	10	0	0	0	168	1
July	275	651	349	39	0	0	539	0	28	0
Aug.	1313	1345	219	30	0	1	1	0	34	0
Sep.	767	618	124	6	0	0	0	0	23	0
Oct.	565	214	451	2	0	0	0	0	19	....
Nov.	773	494	131	1	0	0	0	0	12	....
Dec.	366	256	27	1	0	0	0	0	4	....
Total	4327	6715	2294	372	15	4	540	0	873	....

BEE DISEASE ERADICATION

Quarterly Report for Period Ending September 30, 1923

Number of apiaries inspected	266
Number of apiaries infected with American foul brood	5
Number of colonies inspected	6,076
Number of colonies infected with American foul brood	7
Number of apiaries infected with European foul brood	0
Number of colonies infected with European foul brood	0
Infections were found in Orange, Pasco and Volusia Counties	3

Orange County, 1 apiary, 1 colony
Pasco County, 1 apiary, 1 colony
Volusia County, 3 apiaries, 5 colonies

THE QUARTERLY BULLETIN

State Plant Board of Florida

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FURTHER EXPERIMENTS WITH THE FLORIDA METHOD OF BOLL WEEVIL CONTROL

By

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In the October, 1922, issue, Volume VII, No. 1 of the Quarterly Bulletin of the State Plant Board of Florida, there was described an improved method of boll weevil control. The information published was based upon the results obtained in certain experiments conducted by the Plant Board at Madison, Florida. The same information was published in a bulletin of the Florida Agricultural Experiment Station, No. 165. Both contributions appeared under the title "A Preliminary Report Upon an Improved Method of Controlling the Boll Weevil". The method described was subsequently designated by the Hon. Henry C. Wallace, Secretary, United States Department of Agriculture, as "The Florida Method".

At the time the preliminary report was published it was realized that further studies might make the method more effective. It was also recognized that weather conditions play a very important role in the effectiveness of the control operation. It had been demonstrated that powdered calcium arsenate must remain on the plants from forty-eight to seventy-two hours without the occurrence of rain to insure maximum weevil control. The possibilities of the method were accordingly somewhat lessened under average Florida conditions. Therefore, the research work for 1923 was planned with a view to finding a method of applying the poison which would give a quicker mortality and thus enable the cotton grower to secure effective control under average weather conditions.

During the season of 1923 rain fell almost daily from May 14 to August 7. In spite of this handicap the net results of the experiments indicate that upland cotton can be profitably grown in northern Florida, even under adverse weevil and weather conditions.

THE FLORIDA METHOD OF BOLL WEEVIL CONTROL

Briefly stated, the Florida Method consists in clearing the field early in June of all adult weevils, and, at the same time, destroying their eggs and larvae; thus leaving the cotton plant free to develop squares and bolls without weevil interference for the succeeeding seven or eight weeks.

Two separate and distinct operations are included in this method. The first operation, known as square stripping[1], consists of removing all blossom buds or squares from the plants on or about June 5; by which date practically all weevils are out of hibernation. The square stripping operation and, at the same time, the collection of all fallen squares, insures the destruction of all immature weevil stages. In addition, approximately 80 per cent of all the adult weevils are captured and destroyed along with the squares.

The second operation consists in applying poison, preferably calcium arsenate, to the buds of the plants. If the poison is properly applied, the few adult weevils that were missed when the squares were stripped are killed within approximately three days.

The treated field is then practically safe from weevil damage until the annual summer migration takes place—ordinarily seven or eight weeks later. By the time re-infestation occurs, the treated fields will have normally set practically a full crop of cotton, it having been found that the few straggling weevils that may emerge from hibernation after June 5 will not normally affect the total yield of seed cotton.

By the time of the annual summer migration, July 25 to August 1, upland cotton bolls, which are more than half grown at the time of the migration, succeed in maturing and opening, because the first migratory weevils arriving in the fields late in July turn to the squares and do not attack the green bolls to any great extent.

Before the boll weevil appeared in Florida the cotton crop was normally "made" by the middle of August. On the Florida sandy soils the cotton plant shows a determinate habit of growth; that is, it reaches maturity about the first of August and does not normally make any appreciable amount of cotton after that time. Cleaning the cotton fields of weevils early in June, there-

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[1] "Square stripping", "stripping" and "square removal" are synonymous terms and refer to the removal from the cotton plant of all blossom buds or squares.

fore, affords the plant almost as long a period in which to set fruit as it enjoyed in a normal season prior to the advent of the weevil.

Effect of Square Stripping on Yield

Many cotton growers might think that removal of the first two or three squares per plant would decrease the yield of cotton. Carefully conducted experiments at the Madison, Florida, laboratory of the State Plant Board show that removal of the first squares increases the tendency of the plant to set fruit.

It is true that heretofore the cotton grower has attached great importance to the first squares, considering them the substance of his first or bottom crop, and has based his crop prospects on the setting of as many early bolls as possible, knowing that the weevil would not permit the maturing of later ones.

Under normal conditions the removal of the first squares causes a marked growth of the plant for a period of about a week or ten days and this stimulation of plant growth is followed by a remarkable fruiting stimulation, squares developing from the bottom to the top of the plant at about the same time. The increased tendency of the plant to set fruit forces all three crops—bottom, middle and top—to mature in about the same length of time.

Relation of Date of Planting to Weevil Control

The date of planting is very important where the Florida Method is used. In northern Florida the weather is usually warm enough to permit planting by March 10, and some cotton is planted at this very early date. After several years observation it has been determined that cotton planted without fertilizer, or with a small amount of fertilizer, about the last week in March will be in just about the proper stage for removing the squares and poisoning on June 5. If liberal applications of fertilizer are used it is best to delay planting until about April 5. Should the season be late, the treatment can be delayed a few days or until enough squares have appeared on the plants to act as traps for the adult weevils.

On the other hand, planting too early, especially if the season is an early one and the cotton grows rapidly, involves a great deal more labor for picking the squares at the time the cotton is

treated. It must be remembered that the rate at which the weevils emerge from hibernation is not accelerated by an early season to the same degree that the growth of the cotton plant is and, regardless of whether the season is early or late, the treatment for the weevil should not be given earlier than June 5. Extremely early planted cotton often produces enough squares to produce a generation of adult weevils during the last week in May, before all over-wintered weevils are out of hibernation. It is advisable to plant the cotton only moderately early, say the last week in March, and have the plants in the proper stage of development for treating on June 5.

Relation of Late Planting to Weevil Control

The theory that late planting of the cotton crop would result in control of the boll weevil has received a great deal of publicity over the South during the past fifteen years. This theory is to the effect that cotton planted late would not produce squares until late in June or early in July and would escape weevil damage because all over-wintered weevils would be out of winter quarters and nearly all of them would be dead before squares developed on the plants. The plan cannot be successfully used under Florida conditions for two main reasons. In the first place, a great many of the last weevils to emerge from hibernation would still be alive at the time squares are developed and, in the second place, late planted cotton does not have time to produce a satisfactory crop before the annual summer migration of weevils takes place from fields of earlier planted cotton.

Even where the Florida Method is used the very late planting of cotton is dangerous, as the plants are so small and their root systems so poorly developed in June that it is almost impossible to produce a crop of bolls before the annual, or summer, migration of weevils occurs from untreated cotton fields. It is better to plant the crop too early than too late. The best planting date, as already indicated, appears to be about the last week in March. The larger the cotton plant at the time of taking off the squares the greater the amount of cotton produced within the seven or eight weeks of comparative weevil freedom. At the same time, when the cotton is planted too early the cost of removing the squares is increased, as is also the probability of some squares being overlooked by careless laborers at the time of treatment.

Time Necessary for Poison to Remain on Plants to Secure Best Results

The length of time necessary for calcium arsenate to remain on the plants to secure satisfactory results has been very carefully studied under northern Florida conditions. Practically all weevils were killed in from 48 to 72 hours as a result of dusting immediately after removing the squares. There is little occasion for the poison remaining on the plants longer than 72 hours, owing to the fact that new plant growth takes place rapidly and the weevils feed on the new growth in preference to the poisoned parts of the plant.

The fact that two or three days are necessary without rain after one application of dust poison in order to secure a high mortality indicates the difficulty of dusting for weevil control in Florida, where the annual summer rainfall is perhaps heavier than in any other section of the cotton belt. Rainfall in Florida constitutes a limiting factor to weevil control by dusting. Indeed, in some sections during 1923, if a single dusting or the use of dust alone had been depended upon, successful control would have been unattainable.

Relation of the Feeding Habits of the Weevil to Control

The feeding habits of the weevil offer one of the best suggestions for the successful application of poisons. In early spring, before the cotton plants develop squares, the over-wintered weevils feed mainly in the tender buds of the plants and can be more easily poisoned at this time than during any other season of the year. After the plants develop squares the adult weevils enter the "shucks", or involucres, surrounding the squares and do most of their feeding on the tender tissue which is protected by the surrounding shuck. There seems to be little inclination to feed in the plant buds as long as there is a plentiful supply of squares on the plants.

Before squares are developed the weevil can be successfully poisoned by dusting the plants with calcium arsenate or by using a mixture of calcium arsenate and syrup and, if all weevils were out of winter quarters at this time, early poisoning would insure highly satisfactory control. While feeding in the tender buds the weevils rasp the tender tissue with the two jaws situated on the end of the beak or proboscis and suck at the same time. If a particle of poison happens to be on the minute pieces of plant

tissue swallowed by the weevil death results within a period of from one to three hours.

After squares develop on the plants it is very difficult to poison the weevil successfully, very heavy applications of poison being required to secure effective control even under the most favorable weather conditions. The shucks around the squares offer protected situations for feeding purposes and it is difficult, even with the improved types of dust gun, to force the poison into the shucks and onto the squares themselves.

The Use of Syrup in Weevil Control

In Circular No. 33, second series, Division of Entomology, United States Department of Agriculture, published July 1, 1898, Doctor L. O. Howard reported that the weevil was fond of sweets and the efficacy of poisoning might, therefore, be enhanced by the addition of molasses. Doctor Howard's recommendation concerning the use of molasses constitutes, so far as the writer has been able to determine, the first recommendation of the use of sweets in boll weevil control. He advised the use of poisoned molasses while the cotton plants were small. A stronger mixture of poison and molasses was recommended for volunteer and seppa cottons.

In 1902 Professor F. W. Mally, professor of entomology at the Agricultural and Mechanical College of Texas, recommended a spraying formula consisting of one ounce of white arsenic, one pound of arsenate of lead, one gallon of molasses and twenty-five gallons of water. Professor Mally recommended spraying while the cotton plants were young, preferably during May, but in no event later than June.

Syrup mixed with poison has been in use for a number of years. It is doubtful if any one individual is responsible for the development of the poisoned-syrup idea. However, Mr. D. R. Coker of Hartsville, South Carolina, has repeatedly called attention to the results of the experiments, with poisoned-syrup mixtures, conducted on his large farm at Hartsville, and has perhaps been more influential in the promotion of this method of weevil control than any other man.

Are Weevils Attracted to Syrup?

The very high mortality secured from the use of small amounts of calcium arsenate mixed with syrup, as compared to the slower and lower mortality resulting from dusting the poison on the

plants, indicates that the use of syrup may be of considerable importance in weevil control. The results of cage tests and field experiments at Madison, Florida, laboratory indicate that there are probably several factors involved in using poisoned-syrup mixtures for poisoning the weevil.

The weevil's sense of smell seems to be very poorly developed and there is no evidence that the weevil is attracted to syrup. Our experiments show that the weevil will often walk within one-sixteenth of an inch of syrup and apparently not detect its presence. On the other hand, if the weevil happens to step in the syrup or touch the syrup mixture with its proboscis it usually stops and eats. The preference for syrup as compared with water has not been determined. However, in one experiment 10 weevils were captured in the field just after a very hard rain and allowed to crawl over a cotton leaf well mopped with syrup. Only one of the weevils stopped to eat the syrup, showing that apparently their thirst had been satisfied by the heavy rainfall. Although the weevils do not seem to be attracted to syrup they readily feed on it.

That the weevil is fond of sweets has been more or less generally accepted. However, the extent to which sweetened liquids satisfy the weevil's thirst has not received much study. It has been known for a number of years that weevils drink water and they are frequently found inside the cotton blossoms. Mr. B. R. Coad of the Bureau of Entomology, U. S. Department of Agriculture, in a press report published July 1, 1916, reported that weevils drink freely of water. Later Newell and Bynum[2] published observations showing that weevils frequently visited dew drops, inserted their beaks in the dew and remained motionless for several minutes, apparently drinking. Their observations were made on weevils confined without food but which were given access to dew collected from plants which had been dusted with powdered arsenate of lead. They commented upon the weevil's desire to satisfy thirst as follows: "Under these conditions the weevils went rather frequently to the dew in the trays and remained with their beaks inserted in the dew for periods varying from 1½ to 5 minutes, 2¼ minutes being about the average. It is assumed they were drinking during these periods."

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[2]"Notes on Poisoning the Boll Weevil", by Wilmon Newell and Eli K. Bynum. Published in the Journal of Economic Entomology, Vol. 13, No. 1, 1920.

The mortality recorded by Newell and Bynum among weevils given poisoned dew on which to feed was surprisingly low. This may be accounted for by the very marked physical differences between dew collected from cotton plants where the poison was applied in dust form and that from poisoned-syrup mixtures. Calcium arsenate or arsenate of lead quickly settles when mixed with water, and apparently the only poison which is imbibed by weevils drinking it is a trace of water-soluble arsenic. In the heavy, sticky syrup mixtures, a considerable portion of the solid particles of calcium arsenate or arsenate of lead remains in suspension through the liquid.

If the poison is dusted on the plants there is only one chance of poisoning the weevil and that is by the weevil swallowing the poison while feeding on the tender tissue of the buds or squares. It seems probable that the cotton grower has two additional chances to poison the weevil when syrup mixtures are used: viz., through the weevil's probable fondness for sweets and the desire to satisfy thirst.

The two methods of applying the poison in the field experiments of 1923 are illustrated in Figures 1 and 2. The dust poison was applied by means of a dust gun which forced the poison into the terminal buds of the cotton plants by means of a blast of air. The "mopping method" was used for applying the poisoned-syrup mixture; that is, mops constructed by tying burlap rags, cornshucks, or some other pliable material to the end of a stick were dipped into the mixture and then pressed into the buds of the plants.

FIELD EXPERIMENTS OF 1923

The field experiments conducted during 1923 were in every sense of the word a continuation of the experiments of 1922, the only difference being that in the 1923 tests the poison was applied mixed with molasses as well as in the dust form. Since effectiveness and a rapid action of the poison are very important considerations where the Florida Method is used, and more especially under rainy weather conditions, the experiments were planned to determine the comparative value of both methods of applying the poison.

The field tests conducted at the Madison, Florida, laboratory were based on cage test results which indicated that syrup mixtures gave a much quicker as well as greater mortality than did the dust poison. The field tests were arranged to determine the

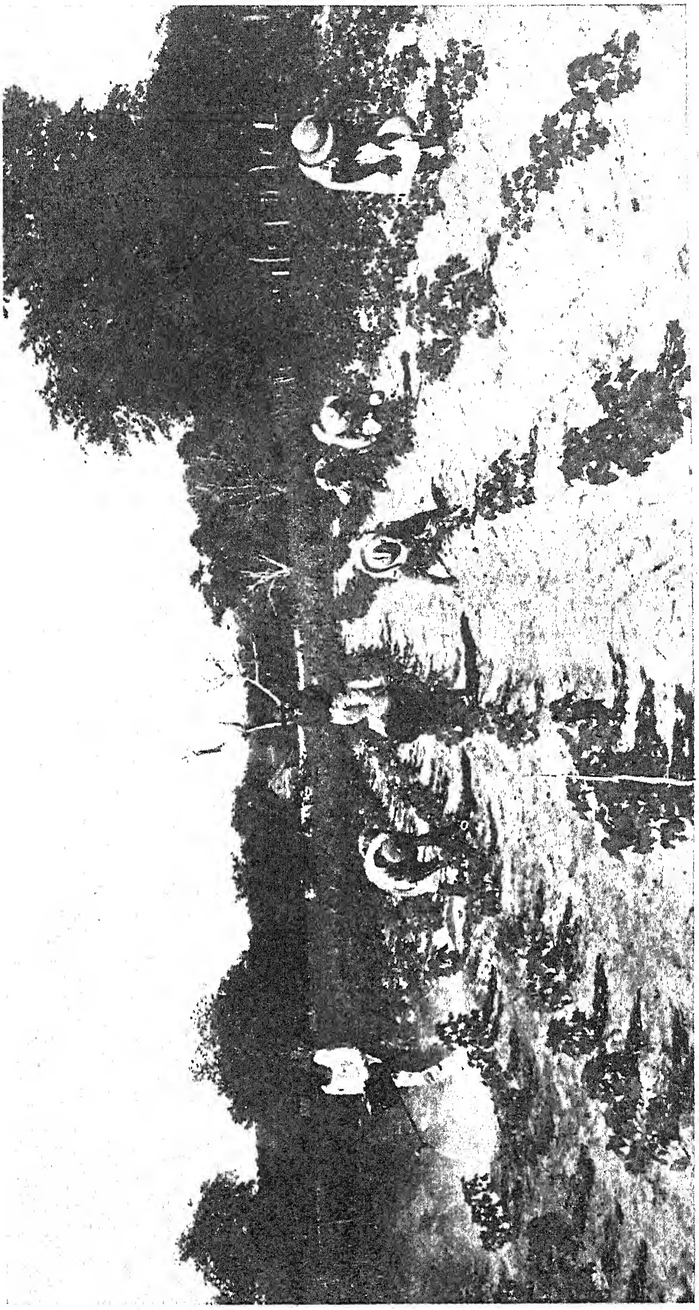

Fig. 1.—Removing the early squares and following immediately with the dust poison. (Original)

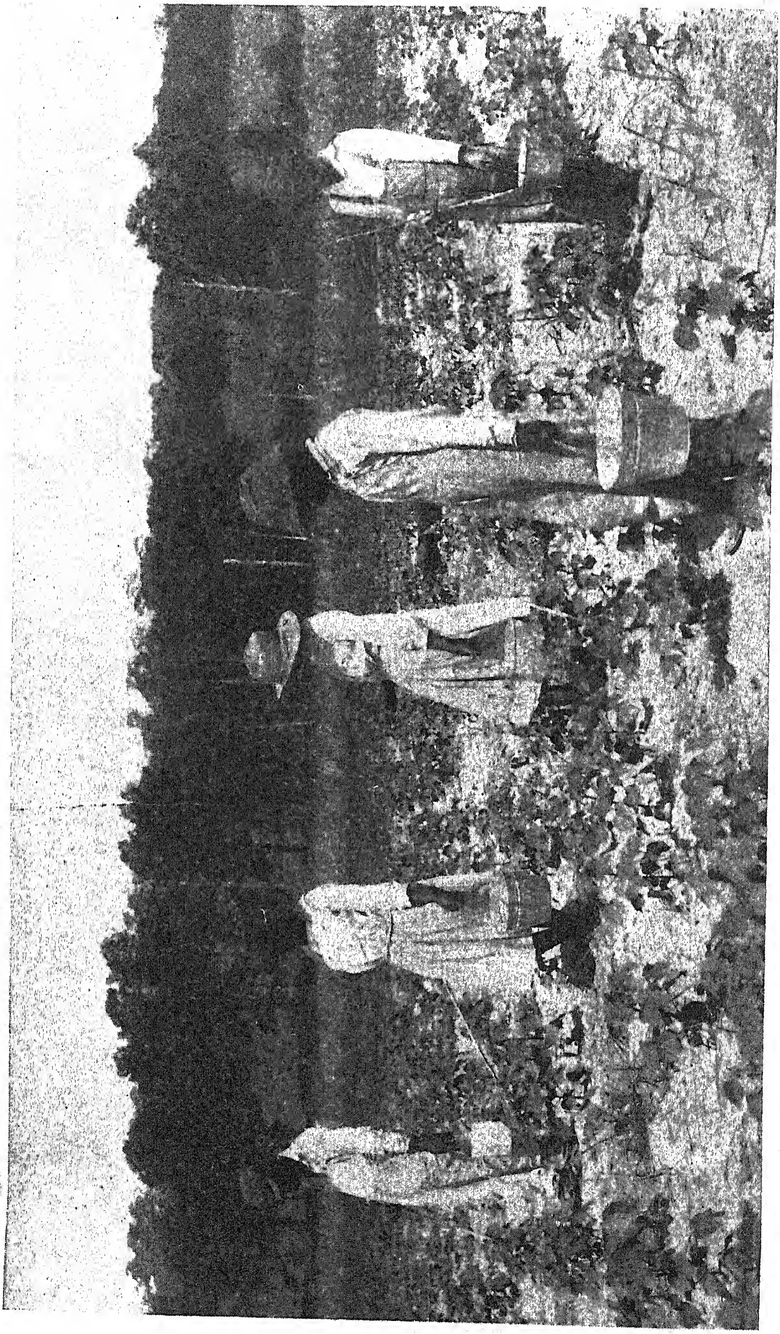

Fig. 2.—Mopping the buds of the cotton plants with a poisoned-syrup mixture after removing the squares. An effective method of applying the poison. (Original)

value of removing the squares and mopping the buds of the plants one time with a poisoned-syrup mixture as compared to removing the squares and making one application of calicum arsenate in dust form.

The syrup mixture which gave the best results under cage conditions was made by mixing two pounds of powdered calcium arsenate in one-half gallon of water and then adding one gallon of syrup. This mixture was used in all field tests where the poisoned-syrup mixture was employed. Under field conditions, where the Florida Method is used, it is of the utmost importance that the cotton grower secure destruction of practically all weevils with one application of poison in from six to twenty-four hours, on account of the probable occurrence of rain.

Arrangement of the Field Tests

The field tests were conducted under as nearly typical field conditions as it was possible to secure.

In the field experiments described on subsequent pages efforts were made to secure large fields for treating with the Florida Method, with nearby fields left as check or untreated fields. The fields, both treated and non-treated, were so chosen that the surrounding weevil hibernation quarters, drainage and soil conditions were as nearly similar in every respect as possible. Each field or plot was carefully measured to determine the acreage. The removal of the squares as well as the application of the poison was in most cases under the direct supervision of the writer or one of his assistants. In the few instances where this practice was not followed explicit directions and demonstrations were given to the owner, who then applied the treatment. The seed cotton produced on each plot or field was carefully weighed and recorded. Accurate records were kept of all labor and material costs.

Removal of Squares

The squares were stripped from the plants only once. However, it was sometimes found necessary, in order to secure a perfect clean-up of the immature weevil stages, to have the laborers immediately go over the field a second time. Each laborer carried one row during the first stripping operation but in going back over the field the second time the laborer was instructed to carry two rows and look well ahead in order to see any squares that were missed at the first operation. The second operation

required only about one-tenth as much time as the first. All fallen squares were picked up and destroyed. The method of removing the squares is illustrated in Figure 5. Attention is called to the small bags or sacks used by the laborers. The sacks have a double draw-string to keep the mouth closed in order to prevent the escape of any adult weevils. Buckets or other open receptacles should not be used for collecting the squares.

Methods of Applying the Poison

The machine used in all dusting experiments was a hand dust gun from which the poison was driven onto the plants by a blast of air. The strong air current generated by the dusting machine forced the poison well down into the buds of the plants. On account of the weevil's habit of feeding in the tender buds during the early season any machine used in dusting must in some manner force the poison into these feeding locations. Shaking the poison from sacks onto the plants does not give good results because the poison is not forced into the buds with sufficient force.

In all experiments in which the poisoned-syrup mixture was used it was applied to the buds of the plants by means of "homemade" mops. One of the most satisfactory mops was made by tying a strip of burlap, about four inches wide, around the end of a small stick 18 to 24 inches long. The lower end of the burlap was then slit with a knife to make it pliable and less liable to injure the tender plant-buds. Another type of mop was made by tying a corn shuck around the end of a stick, cutting the shuck off square at the lower end and then slitting it. The shuck mop gave about as good results as the burlap mop. Long-leaf pine needles tied around the end of a stick also gave good results. The three types of mops are illustrated in Figure 3.

In mopping the cotton plants the mops were pushed well down into the buds. The terminal leaves of the plants did not interfere with getting the poisoned-syrup mixture into the buds. In applying calcium arsenate by means of a dust gun it is necessary to hold the nozzle of the gun close to the bud of the plant to insure successful dusting.

In all poisoned-syrup experiments powdered calcium arsenate and syrup were mixed in a 50-pound lard can. The large can was found very convenient for this purpose. In order to avoid weighing the poison after it was carried to the field, the calcium arsenate was weighed and placed in 5-pound paper bags. By having two pounds of poison in each paper bag the mixing opera-

tion was simplified. The 2-pound charge of calcium arsenate was first mixed in one-half gallon of water and stirred until the poison and water formed a white pasty mixture. Into this mixture one gallon of syrup was slowly poured, the mixture being stirred at

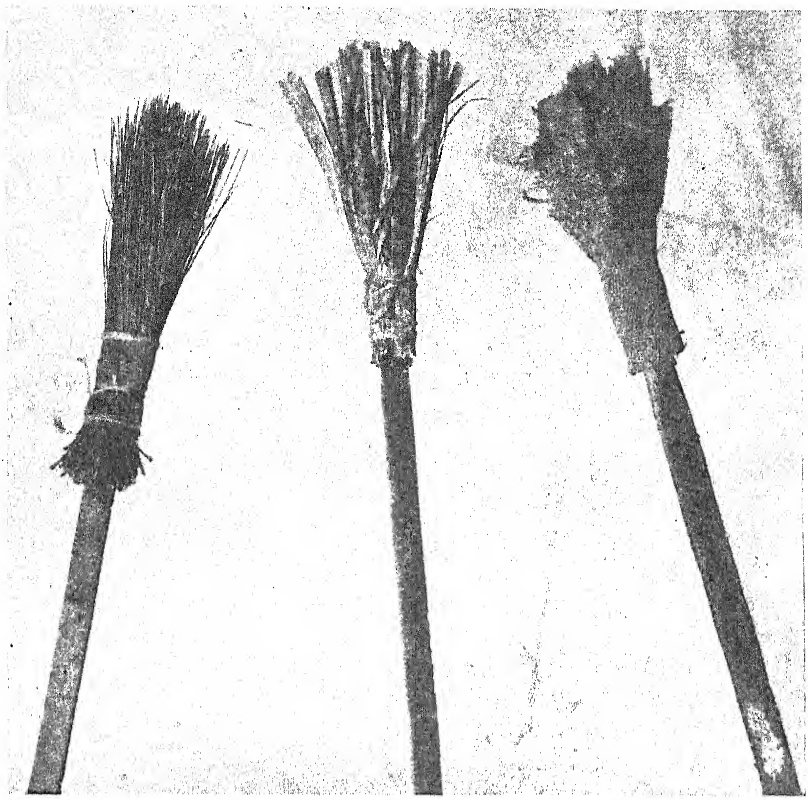

Fig. 3.—Three types of mops used in the 1923 experiments. Left, pine needle mop. Center, mop made of a corn shuck. Right, burlap mop. (Original)

the same time. One-half gallon buckets were found useful for carrying the mixture in the field as a greater quantity was found to be too heavy. Figure 4 illustrates the method of mixing the poison and syrup.

Number of Applications of Poison

Under favorable weather conditions, namely, without rain, one application of poison is effective in connection with the Florida Method of control. However, it was much more difficult to secure

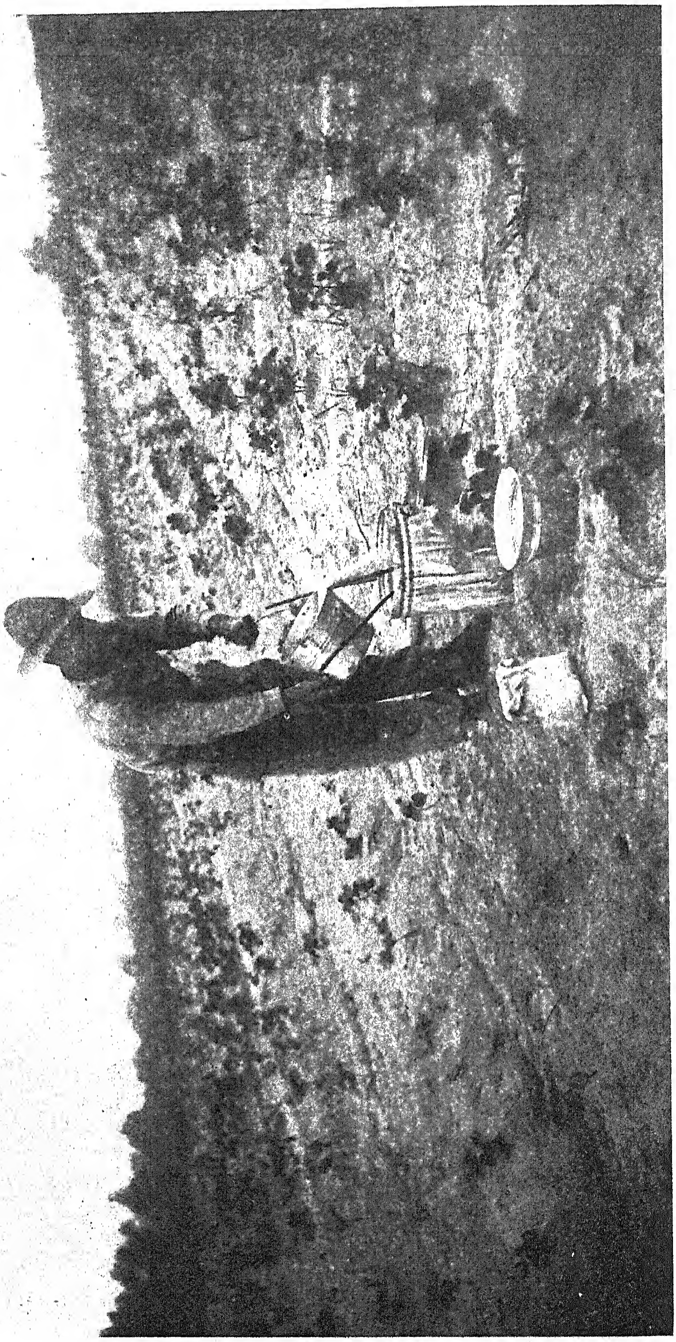

Fig. 4.—Mixing calcium arsenate and syrup in a 50-pound lard can. (Original)

an effective application in the dust form than with the poisoned-syrup mixture. In some experiments where the poison was applied in the dust form two or three applications were required on account of the first applications being washed off too soon after they were made to the plants. Also, in some of the experiments in which the poisoned-syrup mixture was used, the plants were mopped two or three times as rain washed the poison off the plants within two hours after its application. However, if the buds of the plants were mopped with the poisoned-syrup mixture late in the afternoon, and no rain occurred before noon of the following day, a second application was not considered necessary.

On account of frequent rains, it was found necessary to curtail the size of the dusted plots, in most experiments not more than one acre being included, in order to be able to repeat the application of dust poison without loss of time in case rain interfered with the experiments. On the other hand, satisfactory control was secured by the use of poisoned-syrup mixture in such a short space of time that it was possible to include somewhat larger acreages in this series of experiments.

Description of Experimental Plots

As has been stated, certain fields were selected early in the season for conducting the experiments. Some of these were used for experiments in dusting the cotton plants with poison after square removal and others in combining square removal and the application of poisoned-syrup mixture. In some fields both methods were used. For purposes of identification and record keeping each field or tract was given a number. A brief description of the experimental plots follows:

Experiments in Which the Poisoned-Syrup Mixture Was Used

Plots A-1 and A-2 were located on J. T. Woodard's farm. The experimental plot was planted the last week in March to a mixed unknown variety of upland cotton. Both plots were treated between May 25 and 28 by removing the squares and applying the poisoned-syrup mixture to the buds of the plants. The cotton was left very thick in the drill, which resulted in a rather high labor cost for stripping the squares. A small amount of stable manure was applied at planting time.

Plots B-1, B-2 and B-3 were located on V. Porter's farm. The cotton was planted the last week in March to an unknown variety of upland cotton. Kainit, at the rate of 100 pounds to the acre, was applied as fertilizer. The stand was very uniform in all the

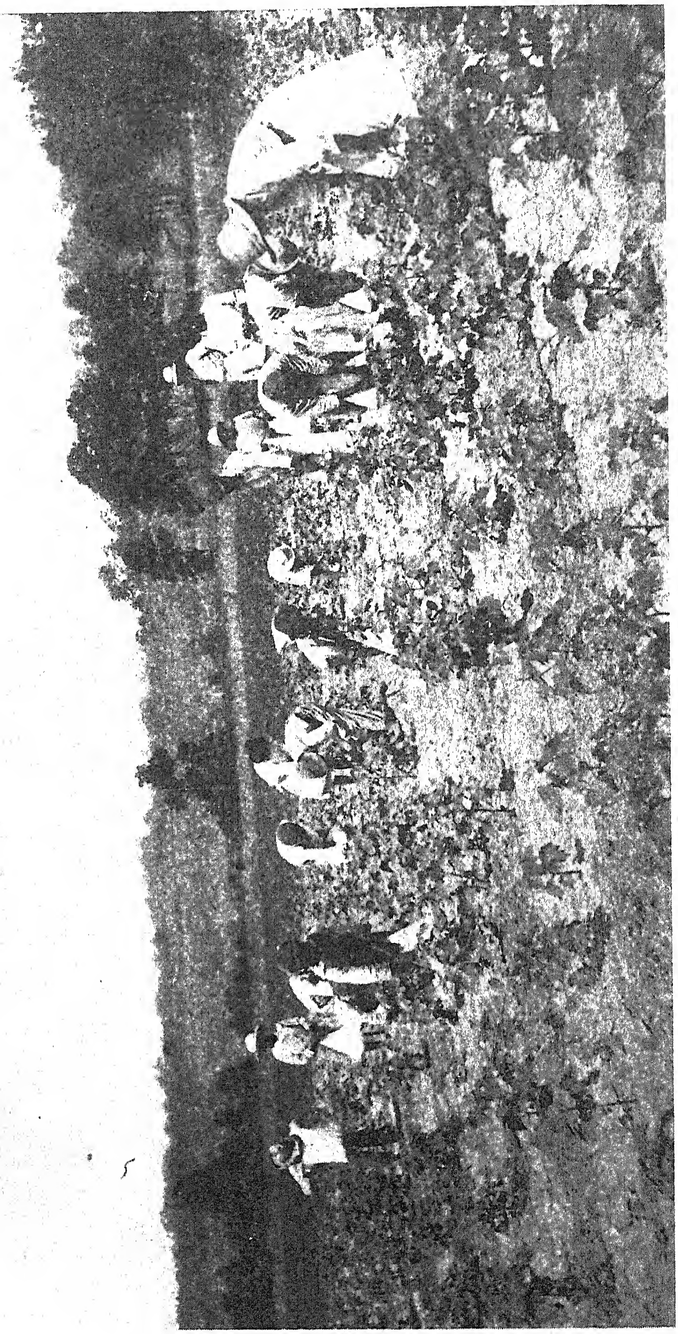

Fig. 5.—Removing squares from the cotton plants before applying the poison. (Original)

plots and the cotton averaged about six squares per plant at the time of treatment on June 5.

A large field owned by R. Flowers was used for Plot C-1. The experimental plot was planted the last week in March to a mixed variety of upland cotton which was well developed on June 4 when treatment was begun. Practically no fertilizer was used. The land had been in corn and velvet beans the previous year and was in a good state of fertility.

Plots D-1, D-2 and D-3 were located on the farm of J. J. Sales. The cotton in all plots was damaged considerably by the heavy rains during the growing season. The non-treated or check plots were located just across the roadway from the treated plots. All experimental areas were planted during the last week in March to a variety of upland cotton, locally known as "Perry". The weevil control treatment was given on June 8. About the only difference in the plots was the very poor soil in Plot D-3. Most of the soil in this plot had washed away, leaving what is locally called a "clay-gall" condition, which accounted for the low yield secured.

Plots E-1, E-2 and E-3 were located on the plantation of J. Owens. The experimental areas were fairly uniform and subject to about the same weevil infestation as the check or non-treated plots. The cotton in all treated fields was planted the last week in March to the variety of cotton known as "Lewis 63". All plots were treated on June 7.

Plots F-1, F-2 and F-3 were located on the S. A. Smith plantation. The planting and cultivation of the experimental plots was under the supervision of A. Kelly. The treated and check fields were planted during the last week in March. Kainit, at the rate of 100 pounds to the acre, was applied as fertilizer. The plots were located side by side in the same field and were exposed to approximately the same weevil infestation. The squares were removed and poison applied from June 11 to 14. The soil was poor in all plots.

Plot G-1 was planted and cared for by a colored farmer by the name of John Robinson. The experimental fields were planted to Lewis 63 cotton seed on March 20. A very poor and irregular stand of cotton was secured on both treated and check fields. The experimental field was bordered on three sides by moss-covered timber which furnished unusually favorable hibernating quarters for the weevil. The cotton was treated on June 4 and 5. No fertilizer was used with this cotton.

Plots H-1 and H-2 were cultivated by a colored farmer by the name of William Johnson. Both experimental plots were planted the last week in March to Lewis 63. A poor stand was secured on both plots. The soil was rather poor and no fertilizer was used. The squares were removed and the poison applied on June 4. Splendid weevil control was secured, as is shown by the infestation records. The low yield of seed cotton was due largely to the impoverished condition of the soil.

Plot I-1 was located on a plantation owned by S. H. Hadden. A mixed variety of upland cotton seed was planted during the last week in March. The cotton was not treated until June 14, and as a consequence considerable damage was done by the extraordinarily early summer weevil migration. No fertilizer was used.

Boswell Johnson, a colored farmer, owned and cultivated the cotton in Plot J-1. Lewis 63 cotton seed was planted during the last week in March. A very poor stand was secured on the poor sandy soil. No fertilizer was used. The squares were removed and poison applied on June 11 and 12. The weevil control was excellent, as is shown by the infestation records.

Experiments in Which Powdered Calcium Arsenate Was Used

A number of experiments were made in which powdered calcium arsenate was applied in dust form. All of the plots in which this procedure was followed were located on farms where poisoned-syrup experimental plots were also located. The same "check" plots were used for both lines of experiments. In all respects the dusted and mopped plots were treated alike except that in one the poison was applied to the buds of the plants, after removal of the squares, by means of a hand dust gun, while in the other it was put on in the form of a poisoned-syrup mixture by means of a mop. In the dusting operation calcium arsenate was used at the rate of about five pounds to the acre.

The dusted plots were listed and located as follows:

Plot K-1 on J. T. Woodard's farm.
Plot L-1 on V. Porter's farm
Plot L-2 on V. Porter's farm
Plot M-1 on R. Flower's farm
Plot N-1 on J. J. Sales' farm
Plot N-2 on J. J. Sales' farm
Plot N-3 on J. J. Sales' farm

Plot O-1 on J. Owens' farm
Plot P-1 on S. A. Smith's farm
Plot P-2 on S. A. Smith's farm
Plot Q-1 on S. H. Hadden's farm.

Infestation Records in Mopped Plots

Counts of the number of punctured squares in each plot were made on July 1, July 15 and August 1. The percentage of squares punctured by the weevil and recorded for all plots where the squares were removed and the buds of the cotton plants were mopped with the poisoned-syrup mixture is presented in Table 1. In studying the infestation records of treated and non-treated or check fields attention is called to the fact that usually the same check field served for both mopped and dusted plots. In other experiments there was a separate check plot in connection with each mopped and each dusted experiment.

TABLE 1
INFESTATION BY THE BOLL WEEVIL IN MOPPED PLOTS

Plot No.	Percentage of infestation, treated plots			Infestation on non-treated or check plots		
	July 1	July 15	August 1	July 1	July 15	August 1
A-1*......	1.71	100. *	........*	10.60	50.48	....
A-2	1.12	77.53*	....	10.60	50.48	....
B-1	2.06	4.93	23.82	13.67	46.04	53.71
B-2	0.0	5.31	8.02	13.67	46.04	53.71
B-3	0.0	4.38	17.03	13.67	46.04	53.71
C-1	1.45	5.07	59.55	14.74	47.39	57.64
D-1	.62	9.95	54.48	18.01	55.93	54.84
D-2	.16	4.92	40.8	18.01	55.93	54.84
D-3	.15	3.88	48.01	18.01	55.93	54.84
E-1	.16	11.23	24.04	17.66	19.26	35.47
E-2	.33	2.24	18.08	17.66	19.26	35.47
E-3	.16	.64	11.40	17.66	19.26	35.47
F-1	0.0	1.47	13.00	11.58	38.00	52.32
F-2	0.0	.65	9.02	11.58	38.00	52.32
F-3	1.41	7.18	23.74	11.58	38.00	52.32
G-1	.48	.46	6.64	24.00	48.26	56.81
H-1	5.16	2.20	13.11	5.16	8.24	11.32
H-2	0.0	0.0	51.98	5.16	8.24	11.32
I-1	3.24	46.04	68.48	32.72	50.98	64.70
J-1	.96	1.04	15.61	5.16	8.23	11.32
**Avrg.	.97	7.33	19.68	15.27	40.52	48.39

*Experiments A-1 and A-2 were attacked by a leaf spot early in July and the cotton shed most of the leaves and squares; in fact, there were so few squares on the plants on August 1 that the infestation records could not be made. The high infestation on July 15 was also due to the scarcity of squares caused by the leaf spot disease. In Plot A-1 on July 15 but four squares could be found and all showed weevil punctures.

**The averages in the table were obtained by dividing the total number of punctured squares by the total number of squares examined: not by averaging the figures in the corresponding columns.

Table 1 shows that on July 1 there was an average infestation of .97 per cent in all mopped plots, compared with an infestation of 15.27 per cent in all check fields. On July 15 the square infestation in the treated plots had increased to 7.33 per cent, compared with the relatively heavy infestation of 40.52 per cent in the check of non-treated fields. On August 1 the infestation was increasing rapidly owing to the presence of large numbers of migratory weevils. However, there was still a very marked difference in the infestation of the treated and non-treated fields on the latter date, as is shown by the infestation records of 19.68 and 48.39 per cent, respectively.

Infestation Records in Dusted Plots

Counts of the number of punctured squares in each plot were made on July 1, July 15 and August 1. The infestation by the boll weevil in all plots where the squares were removed and the poison dusted into the buds of the cotton plants is shown in Table 2. It is interesting to note that the infestation on July 1 in the dusted fields averaged 2.64 per cent, as compared with an average infestation of .97 on the same date in the plots where poisoned-syrup had been used. Likewise, the infestation prevailing in the dusted plots on July 15 and August 1 was higher than the infestation in the mopped plots on the same dates.

TABLE 2

INFESTATION BY THE BOLL WEEVIL IN DUSTED PLOTS

Plot No.	Percentage of infestation, treated plots			Infesation on non-treated or check plots		
	July 1	July 15	August 1	July 1	July 15	August 1
K-1	1.76	86.53*	........*	10.60	50.48	....
L-1	1.78	3.56	14.28	13.67	46.04	53.71
L-2	8.67	9.15	50.00	13.67	46.04	53.71
M-1	3.14	23.30	42.85	14.77	47.39	57.64
N-1	0.0	9.67	11.11	18.01	55.93	54.84
N-2	0.0	1.78	66.07	18.01	55.93	54.84
N-3	3.97	4.36	44.44	18.01	55.93	54.84
O-1	4.77	9.57	36.00	17.66	19.25	35.47
P-1	0.0	.49	43.18	11.58	38.00	52.32
P-2	0.0	5.36	55.55	11.58	38.00	52.32
Q-1	5.27	48.50	55.55	32.72	34.64	64.70
**Avrg.	2.64	12.34	52.84	16.94	44.05	51.47

*The cotton in Plot K-1 was attacked by a leaf spot disease early in July and as a result adequate infestation records could not be taken on August 1.

**The averages were obtained by dividing the total number of punctured squares by the total number of squares examined: not by averaging the figures in the corresponding columns.

TABLE 3

SHOWING TOTAL COST OF REMOVING SQUARES AND APPLYING POISONED-SYRUP MIXTURE TO THE BUDS OF THE COTTON PLANTS*

Plot No.	Acres	Labor				Poison			Syrup			Total cost of treatment to the acre
		Picking squares		Applying poison								
		Total cost	Acre cost	Total Cost	Acre cost	Total pounds	Pounds to the acre	Acre cost	Total gallons	Gallons to the acre	Acre cost	
A-1	3.95	6.20	1.57	1.00	.25	10.	2.5	.40	5.	1.26	.50	2.72
A-2	4.62	7.30	1.58	1.10	.24	12.	2.6	.42	6.	1.3	.52	2.76
B-1	3.13	5.85	1.87	1.13	.36	9.2	2.9	.46	4.6	1.5	.60	3.29
B-2	6.	11.18	1.86	2.16	.36	18.5	3.1	.50	8.8	1.47	.59	3.31
B-3	3.77	7.04	1.87	1.36	.36	11.1	2.9	.46	5.5	1.4	.56	3.25
C-1	26.8	16.08	.60	5.92	.22	54.	2.01	.32	27.	1.0	.40	1.54
D-1	6.36	10.72	1.68	1.53	.24	12.7	2.	.32	6.3	1.	.40	2.64
D-2	12.	20.00	1.67	2.88	.24	24.1	2.	.32	11.9	1.	.40	2.63
D-3	3.6	6.01	1.67	.86	.24	7.1	2.	.32	3.5	1.	.40	2.63
E-1	8.1	4.29	.53	1.60	.19	16.	2.	.32	8.	1.	.40	1.44
E-2	4.5	2.40	.53	.90	.20	9.	2.	.32	4.5	1.	.40	1.45
E-3	2.	1.05	.53	.40	.38	4.	3.8	.32	2.	1.	.40	1.44
F-1	8.	9.04	1.13	1.52	.19	15.5	1.93	.31	7.7	1.	.40	2.03
F-2	10.5	11.87	1.13	1.99	.19	20.4	1.94	.31	10.1	1.	.40	2.03
F-3	5.42	6.13	1.13	1.30	.24	10.5	1.9	.30	5.2	1.	.40	2.07
G-1	3.7	2.75	.74	.95	.26	8.	2.2	.35	4.	1.1	.44	1.79
H-1	5.72	7.44	1.30	1.00	.17	11.	1.9	.30	5.5	1.	.40	2.17
H-2	6.36	7.60	1.19	1.15	.18	13.	2.1	.33	6.5	1.	.40	2.10
I-1	1.05	1.35	1.28	.30	.28	2.	1.9	.30	1.	.95	.38	2.24
J-1	6.54	8.15	1.25	1.20	.18	13.	2.	.32	6.5	1.	.40	2.15
Totals	132.12	$152.45	......	$30.25	......	281.10	....	....	139.6	....	....	....
Average to the acre	....	....	$1.15	....	.23	....	2.13	.34	....	1.05	$ .42	$2.14

*In the table the cost is based on one "effective" application of poison. Plots Nos. A-1, A-2, F-2 and J-1 were mopped twice because rain promptly washed off the first application. The cost of but one application is shown.

The difference in the infestation in all plots where the syrup mixture was used and in the plots where powdered calcium arsenate was used seems to be explained by the syrup mixture causing a higher and quicker mortality among adult weevils. Rain fell practically every day during the time the treatment was being given.

Cost of Controlling the Boll Weevil by Removing Squares and Applying Poisoned-Syrup Mixture

The cost of removing the squares from the cotton plants on June 5 and mopping the buds of the cotton plants with the poisoned-syrup mixture is shown in Table 3. The syrup mixture was made of one-half gallon water, two pounds of powdered calcium arsenate and one gallon of cane syrup. The syrup cost 40 cents per gallon and the calcium arsenate 16 cents per pound. The labor was paid at a rate of 10 cents per hour for adults, 5 cents for children and 7½ cents for women.

The average cost of removing the squares from the cotton plants on the 132.12 acres of cotton (20 plots) where the squares were removed and the plants mopped with the poisoned-syrup mixture was $1.15 an acre. During the time the plots were being treated rain fell practically every day and the laborers accordingly lost considerable time. The wet, muddy condition of the fields somewhat retarded the progress of the square-stripping operation and served to slightly increase the acre cost.

The cost of mopping the cotton plants with the poisoned-syrup mixture, after the squares had been removed, was 23 cents per acre, poison not included. The cost for the syrup and calcium arsenate was 76 cents per acre.

The total cost for the dual treatment of removing the squares and mopping the cotton plants was $2.14 per acre, material included.

Cost of Removing the Squares and Dusting with Calcium Arsenate

The cost of removing the squares and making one application of calcium arsenate at the rate of about 5 pounds per acre is shown in Table 4. On account of unfavorable weather conditions only 11 plots could be included in the series. Daily rains washed the dust poison off the plants and it was necessary to reduce the number of experiments in order that the poison might be reapplied promptly.

The calcium arsenate used in all experiments was valued at 16 cents per pound. The cost of the labor for removing the squares was $1.39 per acre.

TABLE 4

SHOWING COST OF REMOVING THE SQUARES AND APPLYING ONE APPLICATION OF DUST POISON*

Plot No.	Acres treated	Labor				Poison			Total cost of treatment, to acre
		Picking squares		Applying poison		Total pounds used	Pounds to the acre	Cost to the care	
		Total cost	Acre cost	Total cost	Acre cost				
K-1	1 02	1.60	1.57	.30	.29	6.	5.9	.94	2.80
L-1	.82	1.54	1.88	.29	.35	4.1	5.	.80	3.03
L-2	1.73	3.23	1.87	.62	.35	8.6	5.	.80	3.02
M-1	1.34	.82	.61	.25	.19	6.	4.5	.72	1.73
N-1	1.12	1.87	1.67	.23	.20	5.8	5.2	.83	2.70
N-2	1.3	2.17	1.67	.26	.20	6.8	5.2	.83	2.70
N-3	1.36	2.27	1.67	.30	.22	6.9	5.	.80	2.69
O-1	1.5	.82	.55	.25	.17	7.5	5.	.80	1.52
P-1	.47	.52	1.11	.10	.21	2.4	5.1	.81	2.13
P-2	1.17	1.31	1.12	.23	.20	5.96	5.1	.81	2.13
Q-1	.93	1.15	1.23	.20	.21	4.9	5.3	.85	2.29
Totals	12.76	$17.30	....	$3.03	....	64.96	....	....	....
Average to the acre	....	....	$1.36	....	$ .24	....	5.09	$ .81	$2.41

*In the table the cost is based on one "effective" application of poison. Plots K-1, M-1, O-1 and Q-1 were dusted twice. The cost of but one dusting is shown.

In studying Table 4, it will be observed that removing the squares and dusting the buds of the plants with approximately five pounds of calcium arsenate per acre applied by means of a dust gun was more expensive than removing the squares and mopping the buds of the plants with the poisoned-syrup mixture. However, the relative cost of the two methods will vary with the prices of syrup and calcium arsenate.

The Cost of Square Removal

The dusted plots, as a series, were on better soil than the mopped plots and several large fields which were infected with wilt were included in the mopped series of experiments. The soil in some of the mopped fields was very poor, with a correspondingly poor stand of cotton. This reduced the cost of removing the squares. A study of the table will show that in the fields containing both mopped and dusted plots the cost of removing the squares was practically the same. It will also be noted that

the total cost of treating the plots was practically the same when they were located side by side.

The average cost of removing the squares on the 132.12 acres in the mopped series of plots and the 12.76 acres comprising the dusted series was $1.17 per acre.

TABLE 5

PRODUCTION WHERE SQUARES WERE REMOVED AND BUDS OF COTTON MOPPED WITH POISONED-SYRUP MIXTURE

Plot No.	Production, pounds seed cotton to the acre		Increase, pounds to the acre	Value of increase, to the acre	Cost of treating, to the acre	Net profit, to the acre
	Treated	Check				
A-1	455.7	94.	361.7	$37.37	$2.72	$34.65
A-2	140.6	94.	46.6	4.81	2.76	2.05
B-1	710.5	151.4	559.1	57.77	3.29	54.48
B-2	653.4	151.4	502.	51.87	3.31	48.56
B-3	625.4	151.4	474.	48.98	3.25	45.73
C-1	305.9	34.2	271.7	28.07	1.54	26.53
D-1	253.9	133.7	120.2	12.42	2.64	9.78
D-2	228.5	133.7	94.8	9.79	2.63	7.16
D-3*	105.8	133.7	—27.9	—2.88	2.63	—5.51
E-1	167.2	51.	116.2	12.00	1.44	10.56
E-2	105.3	51.	54.3	5.61	1.45	4.16
E-3	382.	51.	331.	34.20	1.44	32.76
F-1	250.5	137.	113.5	11.72	2.03	9.69
F-2	304.4	137.	167.4	17.29	2.03	15.26
F-3	527.4	137.	390.4	40.34	2.07	38.27
G-1	358.6	27.2	331.4	34.24	1.79	32.45
H-1	162.	30.	132.	13.64	2.17	11.47
H-2**	94.	30.	64.	6.61	2.10	4.51
I	292.3	30.	262.3	27.10	2.24	24.86
J	142.2	30.	112.2	11.59	2.15	9.44
Average ***	292.3	84.7	207.6	$21.45 ****	$2.14	$19.31

*This plot was on poorer soil than was the check plot.

**This plot was heavily infected with wilt *(Bacterium malvacearum)* and not over one-tenth of a normal stand was secured.

***The average production of the treated and check plots was obtained by dividing the total production by the total acreage, in each case; not by averaging figures in the corresponding columns.

****In column 5 the $21.45 is secured by computing the value of 207.6 pounds of seed cotton at 27 cents for lint and $40.00 per ton for seed, and not by averaging the figures in the column. In Table 3 the average cost of treating the cotton is shown to be $2.14, which, deducted from $21.45, leaves a net profit of $19.31.

COTTON PRODUCTION

The production records show relatively low yields. The excessively wet summer damaged the crop in most fields and experienced cotton growers state that not more than one-half a

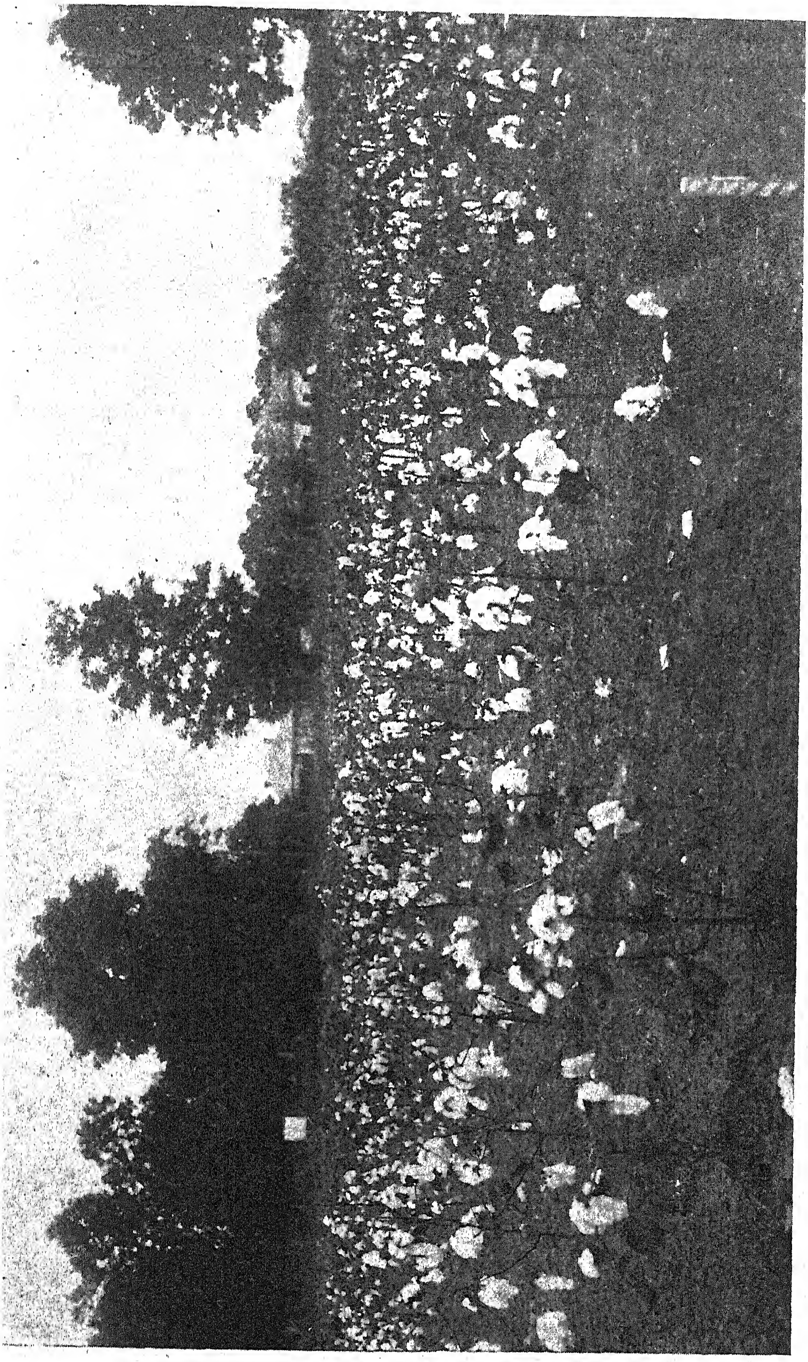

Fig. 6.—Normal cotton production secured by removing squares and mopping buds of plants with poisoned syrup mixture. (Original)

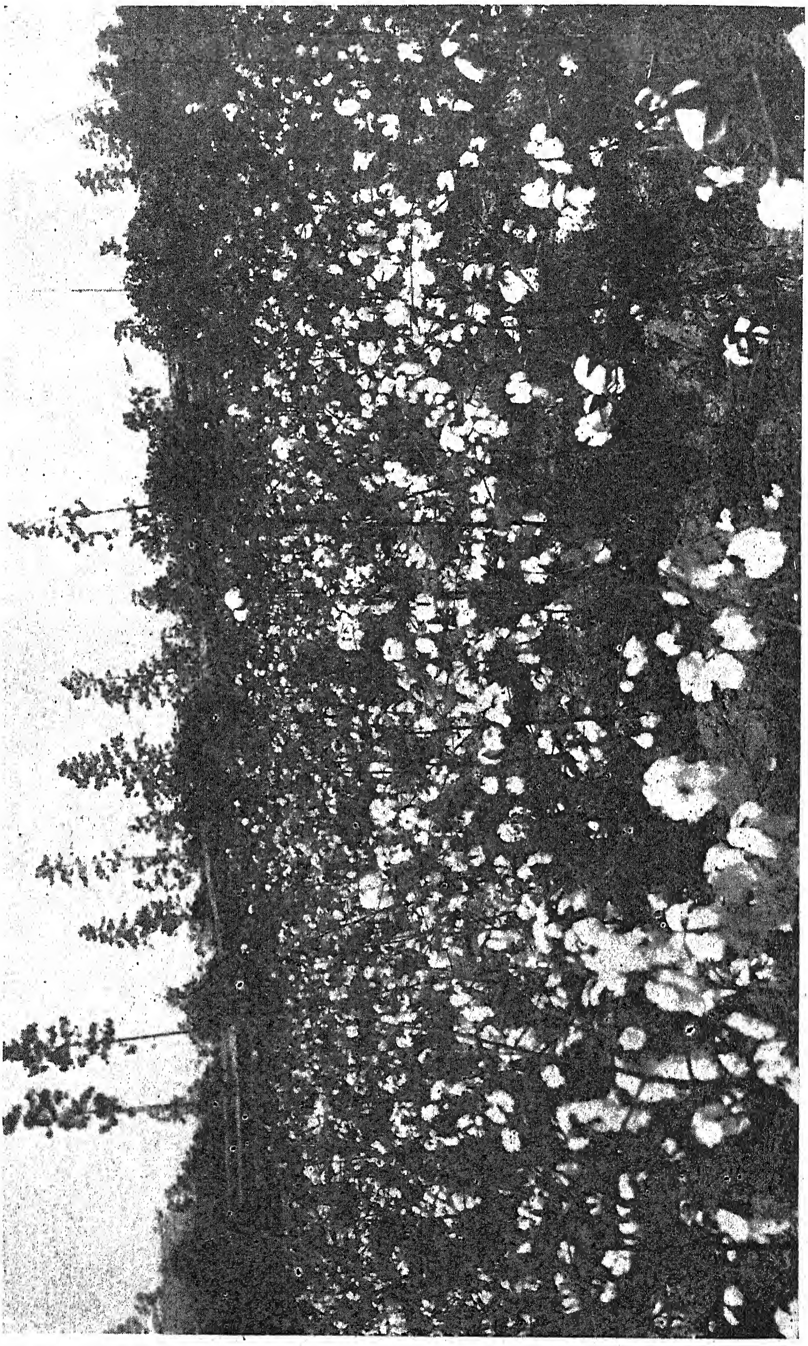

Fig. 7.—Good cotton production secured by Van C. Porter by removing squares and mopping the buds of the plants with poisoned-syrup mixture. (Original)

crop would have been harvested had no weevils been present. Another important factor influencing reduced production was the failure of farmers to use sufficient fertilizer. Another fact must be given consideration: that is, the cotton growing season of 1923 was one of the wettest in recent years. The low production as shown in the tabulation is not greatly out of line with normal yields for Florida's sandy soils as given in the United States Census Report for 1910: 375 pounds of seed cotton per acre. Figures 6 and 7 illustrate clearly the fact that upland cotton can be profitably grown in Florida, by using the Florida Method of weevil control, despite adverse weather conditions.

The treated plots gave a yield averaging 207.6 pounds more seed cotton to the acre than that of the non-treated or check fields. The value of this increased yield would be $21.45 per acre, valuing lint at 27 cents a pound and seed at $40.00 per ton. The average cost of the dual treatment for weevil control was $2.14 an acre, which leaves a net profit of $19.31 an acre for the entire series of experiments. One experiment showed a loss while, in the case of the remaining 19, the profits from the weevil control operations ranged from $2.05 to $54.48 an acre.

TABLE 6

PRODUCTION WHERE SQUARES WERE REMOVED AND COTTON PLANTS DUSTED

Plot No.	Production, pounds seed cotton to the acre		Increase, pounds to the acre	Value of increase, to the acre	Cost of treating, to the acre	Net profit, to the acre
	Treated	Check				
K-1	490.	94.	396.	$40.92	$2.80	$38.12
L-1	590.2	151.4	438.8	45.34	3.03	42.31
L-2	404.6	151.4	253.2	26.16	3.02	23.14
M-1	116.	34.2	81.8	8.45	1.73	6.72
N-1	244.6	131.3	113.3	11.70	2.70	9.00
N-2	208.	131.3	76.7	7.92	2.70	5.22
N-3	295.	131.3	163.7	16.91	2.69	14.22
O-1	158.7	51.	107.7	11.12	1.52	9.60
P-1	301.	137.	164.	16.94	2.13	14.81
P-2	212.5	137.	75.5	7.80	2.13	5.67
Q-1	194.6	30.	164.6	17.00	2.29	14.71
Avrg.*	283.5	107.2	176.3	$18.21**	$2.41	$15.80

*The average production of the treated and check plots was obtained by dividing the total production by the total acreage, in each case, not by averaging the figures in the corresponding columns.

**In column 5 the $18.21 is secured by computing the value of the 176.3 pounds of seed cotton at 27 cents for lint and $40.00 per ton for seed. In Table 4 the average cost to the acre for treating the cotton was shown to be $2.41 which, deducted from $18.21, leaves a net profit of $15.80.

Production Where All Squares Were Removed and Powdered Calcium Arsenate Applied

The production records of the plots where the dual treatment of removing squares and dusting with powdered calcium arsenate was employed are presented in Table 6. The acreage in the plots where the cotton was dusted was comparatively small and the soil was better, on the whole, than the soil in the plots where the squares were removed and poisoned-syrup applied. It will be observed that the average profit per acre is slightly less in the experiments where dust was used.

Weather During the Summer of 1923

The dusting method of weevil control is extremely hazardous in Florida. Weather conditions at Madison, Florida, for the period from May 1 to August 31, are presented in Table 7. Study of the records shows that rains fell almost daily from May 14 to August 7, or throughout the treating and main fruiting season of the cotton plant. A great many Florida farmers bought poison but became discouraged on account of the daily rains and made no effort at weevil control.

The weevil can be controlled by dusting several times, at a rather heavy cost, during a normal season. In 1909 Dr. Wilmon Newell, at that time Secretary of the State Crop Pest Commission of Louisiana, published results secured from a large series of field experiments showing that the weevil could be successfully controlled by dusting the cotton plants with powdered arsenate of lead.

If the Florida Method is used the weevil can be successfully controlled by dusting if as many as two or three days of dry weather follow the application of the poison to the plants. By removing all squares on or about June 5 and mopping the plants with poisoned-syrup the weevil can be controlled under unfavorable weather conditions more cheaply than by any other method now in use in Florida. In fact, this method appears to be the only method the farmer can use successfully under such conditions.

TABLE 7

DAILY WEATHER RECORDS FOR MAY, 1923, AT MADISON, FLORIDA

May	Max. temp.	Min. temp.	Mean temp.	Rainfall inches	Clear or Cloudy
1	90	56	73	.00	Clear
2	73	68	70.5	.00	Clear
3**	82	66	74	.41	Pt. cloudy
4	83	67	75	.00	Pt. cloudy
5**	73	62	70.5	.14	Pt. cloudy
6**	79	60	64.5	.43	Pt. cloudy
7	80	80	70	.00	Clear
8**	78	63	70.5	.14	Pt. cloudy
9	70	54	62	.00	Clear
10	73	46	69.5	.00	Clear
11	82	48	66	.00	Clear
12	84	55	69.5	.00	Clear
13	86	63	74.5	.00	Clear
14	89	68	78.5	.00	Clear
15**	84	70	77	2.05	Pt. cloudy
16**	83	68	75.5	1.50	Pt. cloudy
17	86	67	76	.00	Pt. cloudy
18	89	69	79	.00	Clear
19**	82	69	75.5	.21	Cloudy
20**	78	70	74	1.13	Cloudy
21	80	65	72.5	.00	Pt. cloudy
22**	83	65	74	.17	Cloudy
23**	88	68	78	.18	Cloudy
24**	87	69	78	.80	Cloudy
25**	82	67	74.5	.36	Cloudy
26**	80	68	74	.90	Pt. cloudy
27**	85	65	75	1.00	Pt. cloudy
28**	85	68	76.5	1.50	Pt. cloudy
29**	86	67	76.5	.91	Clear
30**	85	67	76	.42	Pt. cloudy
31**	85	66	75.5	.56	Pt. cloudy
Totals				12.81	
Averages	82.2	64.6	73.3	.41	

Number of clear days 11
Number of pt. cloudy days 14
Number of days in which rainfall exceeded .10 inch 18

*Light rainfall
**Rainfall exceeding .10 inch

TABLE 7 (Continued)

DAILY WEATHER RECORDS FOR JUNE, 1923, AT MADISON, FLORIDA

June	Max. temp.	Min. temp.	Mean temp.	Rainfall, inches	Clear or Cloudy
1	80	68	74	.00	Clear
2	82	62	72	.00	Clear
3*	80	68	74	.05	Cloudy
4**	80	68	74	1.32	Cloudy
5**	85	70	77.5	.19	Cloudy
6**	89	70	79.5	.18	Cloudy
7**	84	72	78	.18	Cloudy
8*	93	73	83	.06	Clear
9	93	73	83	.00	Clear
10**	87	70	78.5	2.02	Cloudy
11*	90	70	80	.05	Cloudy
12	90	71	80.5	.00	Clear
13	83	74	78.5	.00	Cloudy
14**	88	70	79	1.25	Pt. cloudy
15*	91	70	80.5	.01	Clear
16	86	70	78	.00	Cloudy
17**	86	70	78	2.03	Pt. cloudy
18*	91	70	80.5	.03	Pt. cloudy
19*	90	71	80.5	.02	Pt. cloudy
20*	92	70	81	.02	Clear
21	95	71	83	.00	Cloudy
22**	93	70	81.5	.24	Pt. cloudy
23**	84	72	78	.15	Cloudy
24**	86	71	78.5	.29	Cloudy
25*	88	72	80	.04	Cloudy
26**	78	75	76.5	.14	Cloudy
27**	91	75	83	2.00	Pt. cloudy
28	86	76	81	.00	Clear
29**	83	67	75	.26	Cloudy
30*	83	70	76.5	.01	Pt. cloudy
Totals				10.54	
Averages	86.9	70.6	78.8	.35	

Number of clear days 7
Number of pt. cloudy days 7
Number of cloudy days 15
Number of days in which rain fell 22
Number of days in which rainfall exceeded .10 inch 13

*Light rain
**Rainfall exceeding .10 inch

TABLE 7 (Continued)

DAILY WEATHER RECORDS FOR JULY, 1923, AT MADISON, FLORIDA

July	Max. temp.	Min. temp.	Mean temp.	Rainfall, inches	Clear or Cloudy
1	83	70	76.5	.00	Pt. cloudy
2	89	70	79.5	.00	Pt. cloudy
3	89	69	79	.00	Cloudy
4**	89	70	79.5	.70	Pt. cloudy
5*	94	71	82.5	.02	Pt. cloudy
6*	96	74	85	.03	Clear
7	96	74	85	.00	Clear
8*	86	73	79.5	.03	Cloudy
9**	89	70	79.5	.42	Cloudy
10**	89	67	78	1.06	Clear
11*	93	66	79.5	.03	Clear
12	94	75	84.5	.00	Clear
13	98	74	86	.00	Clear
14**	96	76	86	.21	Clear
15*	88	72	80	.04	Cloudy
16**	88	72	80	.90	Cloudy
17**	92	74	83	.86	Cloudy
18**	75	75	75	.18	Cloudy
19**	73	68	70.5	.72	Cloudy
20**	86	69	77.5	1.03	Cloudy
21**	91	71	81	.70	Pt. cloudy
22	93	73	83	.00	Clear
23	95	74	84.5	.00	Clear
24	95	76	85.5	.00	Clear
25	93	76	84.5	.00	Cloudy
26*	94	75	84.5	.09	Cloudy
27*	91	73	82	.01	Cloudy
28	88	74	81	.00	Cloudy
29	82	76	79	.00	Cloudy
30**	84	74	79	.23	Cloudy
31*	84	73	78.5	.02	Cloudy
Totals				7.28	
Averages	89.4	72.3	80.8	.235	

Number of clear days 10
Number of pt. cloudy days 5
Number of cloudy days 16
Number of days in which rain fell 19
Number of days in which rainfall exceeded .10 inch 11

*Light rain
**Rainfall exceeding .10 inch

TABLE 7 (Continued)

DAILY WEATHER RECORDS FOR AUGUST, 1923, AT MADISON, FLORIDA

August	Max. temp.	Min. temp.	Mean temp.	Rainfall, inches	Clear or Cloudy
1**	86	71	77.5	.37	Cloudy
2**	86	71	77.5	.54	Cloudy
3**	82	72	77	.30	Pt. cloudy
4**	84	74	79	.54	Cloudy
5**	85	74	79.5	.36	Cloudy
6**	93	73	83	.10	Pt. cloudy
7*	95	73	84	.01	Pt. cloudy
8	97	74	85.5	.00	Clear
9	96	77	86.5	.00	Clear
10	98	72	85	.00	Clear
11	96	73	84.5	.00	Clear
12	95	74	84.5	.00	Clear
13	92	75	83.5	.00	Cloudy
14	96	74	85	.00	Cloudy
15*	97	73	85	.04	Cloudy
16	96	75	85.5	.00	Clear
17	97	74	85.5	.00	Clear
18	97	72	84.5	.00	Clear
19*	97	71	84	.03	Clear
20	98	71	84.5	.00	Clear
21**	92	74	83	.82	Cloudy
22**	84	74	79	1.41	Cloudy
23*	86	73	78	.01	Cloudy
24**	80	73	76.5	.66	Cloudy
25**	84	76	80	.12	Cloudy
26**	80	73	76.5	.17	Cloudy
27**	90	72	81	.89	Cloudy
28*	92	74	83	.01	Pt. cloudy
29*	80	75	77.5	.02	Cloudy
30**	90	70	80	.98	Cloudy
31**	90	70	80	.89	Cloudy
Totals				8.27	
Averages	90.7	73.1	81.9	.26	

Number of clear days 10
Number of pt. cloudy days 4
Number of cloudy days 17
Number of days in which rain fell 20
Number of days in which rainfall exceeded .10 inch 14

*Light rain
**Rainfall exceeding .10 inch

Cage Tests

Cage tests offer a very effective means of determining the true value of any material used as an insecticide for the boll weevil, as well as the proper amount to use and the most effective method of application. By using both poisoned and non-poisoned cotton plants in separate cages in such tests the insecticidal value of the poison is determined by ascertaining and comparing the daily mortality among the weevils. The value of different amounts of the same poison can be determined in the same way. By removing the squares from the cotton plants after two or three well developed squares have appeared and then making the cage tests the value of the poison is determined.

Tests With Over-Wintered Weevils

Several hundred cage tests were made at the State Plant Board laboratory at Madison, Florida, during the summer of 1923 to determine the value of applying calcium arsenate in dust form, compared with the application of the same poison mixed with syrup. The results of the cage tests with hibernated weevils are presented in Table 8.

TABLE 8

Daily Mortality Among Hibernated Weevils in Cages, Using Poisoned-Syrup Mixture and Calcium Arsenate Dust*

24-hour period after application of poison	Number of weevils dead each day			Per cent of weevils dead each day		
	On mopped plant	On dusted plant	On check or non-poisoned plant	On mopped plant	On dusted plant	On non-poisoned plant
1st	133	67	1	88.6+	44.6	1.8
2nd	15	25	4	10.	16.6	7.2
3rd	2	21	4	1.3+	14.	7.2
Total, 3 days	150	113	9	99.9+	75.2	16.2

*The poisoned-syrup series embraced records of 17 different cage tests with a total of 150 weevils. The buds of the plants were dusted with powdered calcium arsenate in 11 tests which included a total of 150 weevils. The check cages contained 55 weevils.

The data presented in Table 8 indicate quite clearly that syrup mixed with calcium arsenate offers the cotton growers of Florida a more simple and effective agent for weevil control than powdered calcium arsenate used as a dust. On account of the close

proximity of the Florida cotton belt to the Gulf coast, rains frequently blow inland, making the dusting of cotton extremely precarious. The data presented in the above table are graphically shown in Figure 8.

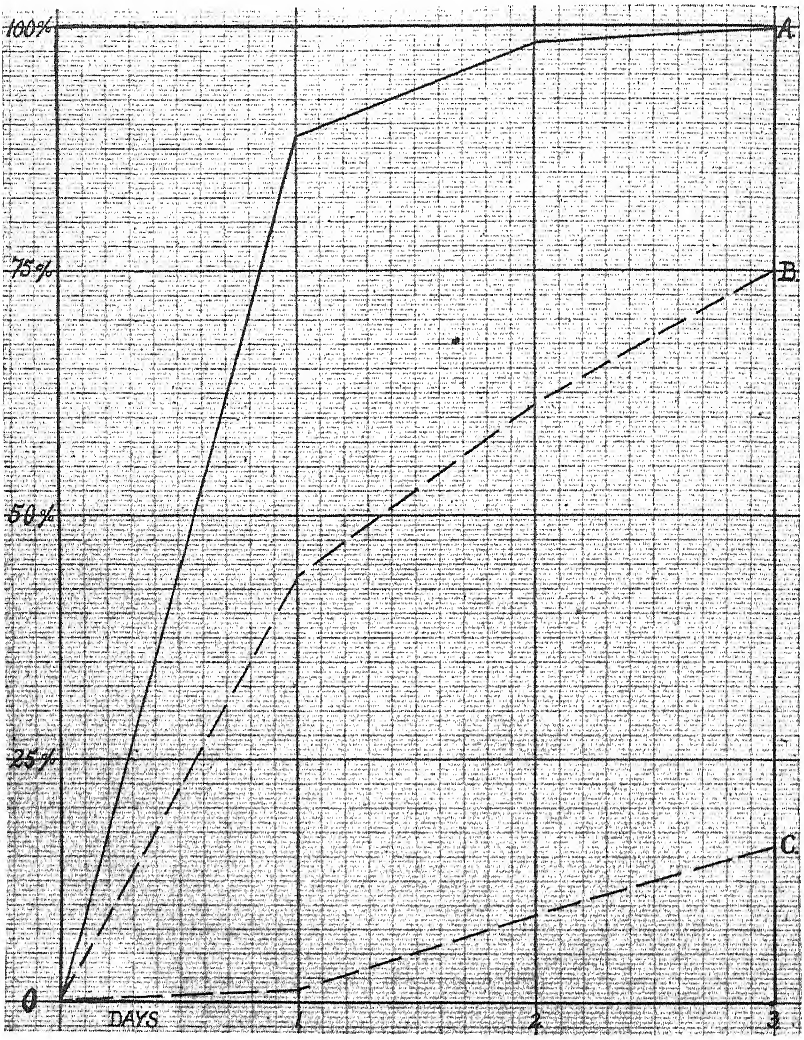

Fig. 8. Showing total percentage of mortality among hibernated weevils where the Florida Method was used.

A—Among weevils feeding on poisoned syrup mixtures.
B—Among weevils where powdered calcium arsenate was dusted on the plants.
C—Natural mortality among weevils feeding on non-poisoned plants.

Results of Cage Tests with Over-wintered, First, Second and Third Generation Weevils

The cage tests were continued throughout the summer, on first, second and third generation weevils, using the poisoned-syrup mixture and the dust poison under the same conditions. The results of this series of tests are recorded in Table 9.

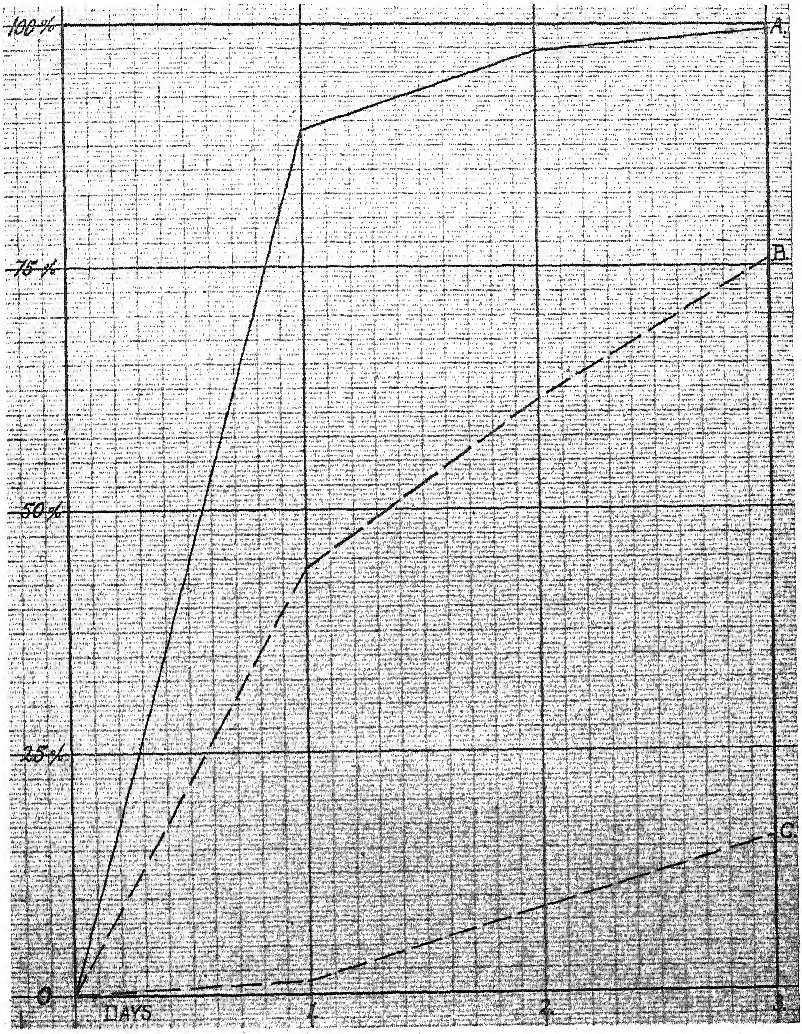

Figure 9. Diagram showing total percentage of mortality among first, second and third generation weevils where the Florida Method was used.

A—Poisoned-syrup mopped on the plants.
B—Powdered calcium arsenate dusted on the plants.
C—Natural mortality of weevils on non-poisoned plants.

TABLE 9

DAILY MORTALITY AMONG BOLL WEEVILS WHEN ALL SQUARES WERE REMOVED AND (1) THE BUDS OF THE PLANTS MOPPED WITH SYRUP MIXTURE AND (2) POISON DUSTED ON THE PLANTS

24-hour period after application of poison	Poisoned Cotton — Percentage of Weevils dead each day: (1) 250 weevils on mopped plants	Poisoned Cotton — Percentage of Weevils dead each day: (2) 201 weevils on dusted plants	Non-poisoned Cotton — Percentage of weevils dead each day: 200 weevils on non-poisoned or checked plants
1st	84.4	34.3	0.5
2nd	14.	12.4	7.
3rd	1.2	10.4	7.
Total, 3 days	99.6	57.1	14.5

The data recorded in this table are graphically illustrated by Figure 9.

AMOUNT OF CALCIUM ARSENATE TO USE IN SYRUP MIXTURE

Undoubtedly the varying success in weevil control where syrup mixtures have been used has been due to a very great extent to the varying amounts of poison used in the mixtures. In order to determine the amount of calcium arsenate that would be necessary to give maximum killing of weevils, when mixed in syrup, a special series of cage tests was conducted during the spring and summer of 1923. The results of these tests are given in Table 10.

TABLE 10

DAILY MORTALITY AMONG BOLL WEEVILS POISONED WITH CALCIUM ARSENATE AND CANE SYRUP MIXED IN VARYING PROPORTIONS*

24-hour period after application of poison	Percentage of Weevils Dead Each Day — Poisoned Cotton: Mixture of 2 lbs. calcium arsenate, ½ gal. water, 1 gal. syrup	Mixture of 1½ lbs. calcium arsenate, ½ gal. water, 1 gal. syrup	Mixture of 1 lb. calcium arsenate, ½ gal. water, 1 gal. syrup	Check or non-poisoned cage
1st	85.0	55.0	45.0	0.0
2nd	13.0	8.0	25.0	1.5
3rd	0.8	20.0	25.0	30.0
4th	0.0	15.0	0.0	1.5
Total	98.8	98.0	95.0	33.0

*120 weevils were used in each series of tests.

The syrup mixture containing two pounds of calcium arsenate gave better results than any other mixture under observation. To secure satisfactory results it is necessary for the poisoned-syrup mixture to contain enough calcium arsenate to kill the weevils quickly. Rains and other unfavorable conditions, such as

evaporation of the syrup by the hot sunshine and the settling of dust over the mixture, interfere to some extent with the effectiveness of the poison. It will be observed in the above table that the two-pound mixture killed a very large percentage of the weevils during the first 24-hour period. By the end of the fourth day all three mixtures had given a very high mortality. However, on account of the desirability of killing as many weevils as possible during the first 24 hours after mopping, the two-pound mixture will be found preferable to the weaker mixtures.

Preference of the Boll Weevil for Different Syrups

A small series of cage tests was conducted to determine the preference of the weevil for different kinds of syrups. However, the series of tests was limited on account of interference by rain and insufficient data were secured.

It seems clear that good grades of syrup are eaten more readily than poor grades. All the good grades of syrups gave entirely satisfactory results. "Black-strap" molasses was not eaten as readily as the good grades of syrup. Syrups that had fermented proved slightly distasteful to the weevil and gave slower mortalities. The Florida cotton growers are advised to use good grades of syrups if they are obtainable at reasonable prices. If the weather is very adverse, with rains falling daily, it is especially important to use the best obtainable grade of table syrup.

Length of Time Different Syrups Hold Calcium Arsenate in Suspension

The different syrups hold calcium arsenate in suspension for varying lengths of time. This fact is of some importance in weevil control. If the poison readily settles, or goes out of suspension, as seems to be the case with some syrups, it appears probable that a weevil could easily drink out of the top of the syrup drop and not swallow any of the poison. Pure cane syrup and Black-strap molasses held the poison in suspension longer than either Japanese or sorghum syrups. The density of the syrup, that is, the amount of water left in the syrup at the time it is made, has considerable influence on the length of time the poison is held in suspension. Thick syrup holds the poison in suspension better than thin syrup.

Spraying Syrup Mixtures

Spraying syrup mixtures is very difficult on account of the spray nozzles choking by the accumulation of poison in the open-

ings. It is possible that a thoroughly sprayed cotton plant would give a much quicker weevil mortality than plants only the buds of which are mopped. This would be especially true if the plants had developed any considerable number of squares. However, where the Florida Method is properly used there are, for a time, no squares left on the plants in which the weevils may hide and they are forced to go to the terminal buds to feed. Then one application of poisoned-syrup, thoroughly mopped on, does effective work.

It is difficult to spray an acre of young cotton with less than six to eight gallons of solution. If the syrup is mixed with equal parts of water, the solution dries out or evaporates very quickly after being sprayed on the plants. When the syrup is mixed with only 50 per cent of its own volume of water it becomes practically impossible to spray the mixture because of the constant choking of the spray nozzles. One of the important features of poisoned-syrup mixtures is their ability to retain the syrupy consistency for a relatively long time. If the syrup is diluted with equal parts of water the hot sunshine soon evaporates both water and syrup and nothing is left but the caked poison.

Importance of Using Freshly Made Syrup Mixtures

It is not out of place to call attention of the Florida cotton growers to the advisability of preparing their own syrup mixtures. Mixing calcium arsenate with syrup and allowing the mixture to stand for any considerable length of time seems to liberate enough water-soluble arsenic to cause serious burning of the cotton plants.

The mixing is very simple. Two pounds of calcium arsenate are first mixed with one-half gallon of water; the mixture being stirred for several minutes, or until it forms a white paste. All lumps of poison should be broken up and the whole stirred until a perfectly smooth, milky liquid is formed. Into this mixture of water and calcium arsenate pour the gallon of syrup. Pour in the syrup slowly and stir well until the poison is thoroughly mixed with the syrup.

There are several proprietary poisoned-syrup mixtures on the market. The writer has tested many of them and, as a result, feels justified in advising the Florida cotton grower to make his own syrup mixture. Why pay some manufacturer a profit to mix calcium arsenate and syrup when the mixing can be done at home?

Summary

At Madison, Florida, during the summer of 1923 the Florida Method of weevil control was given a very severe test owing to the almost continuous daily rains from May 14 to August 7. In most cases where the Florida Method was properly used a profitable crop of cotton was secured, whereas yields ranging from 27 to 150 pounds per acre were the rule in non-treated fields.

Weather conditions during the growing season of 1923 practically prohibited successful dusting of the cotton plants.

A poisoned-syrup mixture made by mixing two pounds of calcium arsenate in one-half gallon of water and then adding one gallon of syrup, when mopped in the buds of the cotton plants, gave much better results than dusting.

Syrup is not attractive to the weevil in the sense that weevils will search for it and congregate around it in numbers. However, weevils like to eat syrup and usually do so when they encounter it.

Mortality records secured under cage conditions and later verified by field experiments, show that after the squares are removed and the buds of the plants mopped with the poisoned-syrup mixture mentioned above, most of the adult weevils are killed within 24 hours. Powdered calcium arsenate dusted onto the plants by means of a dust gun required from 48 to 72 hours to give about the same result.

Mopping the plants after the squares were removed, using two pounds of poison, one gallon of syrup and one-half gallon of water, was found to be cheaper than making one application of calcium arsenate dust, using a rotary fan type of dust gun, at the rate of about 5 pounds per acre.

The Florida Method of weevil control can be effectively used under adverse weather conditions if the poison is applied in the form of a poisoned-syrup mixture. The farmer can remove squares until about 4 o'clock in the afternoon, or until the day's rain has passed, and then mop the plants with the syrup mixture. If no rain falls before noon of the following day a second application of the poison is unnecessary.

The cost of removing the squares varied from $0.53 to $1.88 an acre, depending on the spacing of the plants in the row and the number of squares on the plants at the time of stripping.

A good grade of syrup is preferable to poor grades for weevil poisoning. Any kind of syrup can be used, but the better the grade of syrup the higher the percentage of control that will be secured.

Less than two pounds of calcium arsenate to the gallon of syrup is not recommended. There seems to be little reason for using more than two pounds to the gallon.

Using more than one-half gallon of water to the gallon of syrup dilutes the mixture to a point where very rapid evaporation takes place in the hot sunshine. It is desirable that the mixture retain its syrupy consistency as long as possible.

Mopping with mops made by tying shucks or pieces of burlap on the end of a stick was found to be more successful than shaking the syrup mixture out of a bottle. By gently pressing the mop down into the bud of the plant there is practically no chance of the weevil missing the poisoned-syrup mixture. On the other hand, if a drop or two of the poisoned-syrup mixture is shaken from a bottle onto the top leaves of the plant there is a chance that the weevil will not find the poisoned-syrup until after it has been rendered harmless, either by dew or rapid evaporation.

FLORIDA COTTON GROWING RECOMMENDATIONS FOR 1924

The following recommendations have the full and unqualified endorsement of the staffs of the State Plant Board, and of the Agricultural College, Experiment Station and Agricultural Extension Division of the University of Florida. These recommendations represent, in condensed form, the best judgment of those who have carefully studied the question, as to the course that should be pursued by the Florida cotton farmer during 1924.

Low winter temperatures have led some farmers to believe that the cold weather has killed many of the hibernating boll weevils. However, careful examinations made by the Plant Board entomologists show that in the vicinity of Gainesville practically no weevils have been killed thus far, while at Madison only 38 per cent of the hibernating weevils are found dead from all causes. The cotton farmer must therefore use every practical method of combating the weevil and must, in addition, employ the very best cultural practices.

Soils and Fertilizers

The best soil on the farm should be selected for cotton. Well drained, fertile lands will produce a quicker crop, higher yield and maximum profits as compared with the poor soils.

Fertilizer should be used liberally. On most Florida soils a complete fertilizer containing 8 per cent available phosphoric

acid, 3 per cent available nitrogen and 3 per cent potash seems to be about right. It is a good precaution to have the nitrogen in such a fertilizer derived in part from organic sources and in part from inorganic sources. We recommend from 200 to 600 pounds to the acre, applied well down in the "drill" 4 or 5 days before planting. Farmers can mix their own fertilizers, after buying the raw materials, at a material saving as compared to buying them already mixed.

Side applications of nitrate of soda, in addition to the complete fertilizer applied at planting time, are also likely to prove profitable, especially if the spring is cool or "late" or if the weather is relatively dry. Such applications are recommended to be made at about the time the cotton is chopped out and at the rate of from 50 to 100 pounds to the acre.

Varieties and Planting

The land should be prepared early in order to have a firm, well settled seed bed at planting time. Plant when the soil has warmed sufficiently to insure prompt germination of the seed. If the Florida Method of weevil control is to be used, seed should be planted about the last week in March. It is highly desirable that the same variety should be planted and that planting be done at about the same date throughout the entire community. Plant plenty of seed. Most cotton seed now available in Florida are infected with anthracnose, which causes low germination. About one bushel of seed to the acre is recommended. Rows near together and plants closely spaced will give the highest yields per acre.

Only upland and long staple upland can be recommended under present conditions. The susceptibility of Sea Island to weevil injury is so high that its culture is hazardous.

Of the upland types, Cleveland Big Boll, Express, College No. 1, Cook's Improved, Toole, Bank Account, Deltatype Weber, Lightning Express and other early, improved varieties have given good results.

Land infected with wilt ("black root") should not be planted to cotton if it can be avoided, but if necessary to use such lands, plant a variety known to be resistant or immune to wilt; such as Dixie Triumph, Covington Toole or Lewis 63.

It is best, in the long run, for the farmer to purchase his cotton seed from seedsmen of unquestioned reliability, who specialize in disease-free, selected seed adapted to boll weevil conditions.

Cultivation

Cultivation should be frequent and shallow. Attempt to keep a dust mulch in the field at all times until cotton can be safely "laid by". Cultivations during the growing season should be given at least once a week.

Boll Weevil Control

The farmer should remember that no method of boll weevil control can "make" cotton. The most that control measures can do is to protect the cotton crop while it is being made. It is of the utmost importance, therefore, that the acreage should be kept down to what can be perfectly cared for. Not over six to eight acres "to the plow" is recommended. Not "more acres to cotton", but "more cotton to the acre", should be the slogan.

Pre-Square Poisoning

Cage tests at the Plant Board laboratory at Madison, Florida, during 1923, showed that high mortality among the boll weevils followed application to the cotton plants of a poisoned-syrup mixture made as described in one of the following paragraphs. Weevil experts throughout the South are also agreed that an application of this mixture to the cotton plants at the very first indication of the appearance of squares will be worth while and will kill large numbers of the over-wintered weevils. This application should be made with home-made mops, about May 20th, in the manner described below. This application should be given whether the Florida Method is used or not, but it will not take the place of the Florida Method. The use of both is urged.

Florida Method of Weevil Control*

The Florida Method is undoubtedly the most effective and economical measure that has yet been developed for fighting the weevil under Florida conditions.

Secure two pounds of calcium arsenate and one gallon of a good grade of table syrup for each acre of cotton to be treated. Do not use "black-strap" or other low grade syrup if it can be avoided.

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*The recommendations, based on the experiments described in this bulletin, are primarily intended for the northern Florida cotton belt. Practically all of the control experiments have been conducted at the Madison, Florida, laboratory and further investigations will be necessary to determine whether the Florida Method will give satisfactory results in southern Florida.

For the use of each laborer, make one or more cloth bags, each equipped with a double draw-string that will keep the mouth tightly closed. A yard of unbleached "domestic" will make two bags.

Prepare "mops" for applying the poisoned syrup mixture to the cotton. Tie a 4-inch strip of burlap several times around the end of a 2-foot stick with about 3 inches of the burlap extending beyond the end of the stick. Then slit the burlap several times with a sharp knife. Mops can also be made by tying corn shucks or pine needles to the end of a stick in a similar manner.

On or about June 5 remove all squares from the plants. Place squares in the sacks as gathered and keep mouths of bags tightly closed to prevent escape of weevils. Take squares and weevils out of field and burn them up. Begin removing squares in the part of the field nearest to woods and after going over entire field go over it a second time to get every square in it. Mop the plants immediately after removing squares, making the mixture as follows:

Mix 2 pounds of calcium arsenate in one-half gallon of water, stirring until a white paste is formed. To this add one gallon of syrup and stir thoroughly. A large lard can makes an excellent container in which to do this mixing. The one and one-half gallons will "mop" about one acre of cotton. Using small pails for carrying the mixture, proceed to mop all plants in the field. Dip the mop in the mixture frequently and press mop well, but gently, down into the bud (tip) of every plant. It is not necessary to apply the syrup mixture to the leaves.

If preferred the plants may be poisoned, after squares are removed, by applying calcium arsenate with a dust gun at about 5 pounds to the acre. The cost, labor included, is about the same as that of applying the syrup mixture. However, the syrup mixture will kill about as many weevils within 18 hours after application as will the dust in 48 hours, hence the use of the syrup mixture is a great advantage in rainy weather. In dry weather the results will be about the same in either case.

Both the calcium arsenate dust and the syrup mixture are poisonous and corresponding precautions must be taken with both. Muzzle all work animals, used in the cotton field, for at least two weeks after applying poison.

About two weeks after treating the cotton, it is well to go over the field carefully, looking for punctured squares. Where an infested plant is found, examine all squares within 15 or 20 feet

and remove and burn all squares found infested, as well as all infested squares on the ground.

Ready-made poisoned syrup mixtures have no advantages over the home-made article and are much more expensive.

Late Summer Dusting

On very fertile lands, such as those capable of producing a half bale or more per acre, it may be found profitable to lengthen the period of weevil protection by giving one or two dusted applications of calcium arsenate during July, or at the time when the infestation of squares has reached 15 or 20 per cent. Such late season applications are, however, expensive and sufficient increase in the crop will not be secured to make them profitable on poor or average Florida land.

Plant Diseases

Of the several diseases attacking cotton, there are only two against which the planter can take adequate precautions.

Avoid planting cotton on soils infected with wilt. If necessary to use such soils, plant wilt-resistant varieties as advised above.

Most of the cotton seed at present in Florida is infected with anthracnose, which severely cuts down germination and also manifests itself later in the season by injuring or destroying bolls. Seed kept in storage for 3 years is free from anthracnose but has slightly reduced germination: if used, a liberal quantity should be planted. If possible, secure certified anthracnose-free seed from reliable seedsmen. If obliged to use ordinary seed, plant from one to one and a fourth bushels per acre.

Fall Destruction of Plants

The cotton crop should be picked as fast as it opens and as soon as the crop can be harvested the cotton plants should be totally destroyed, either by cutting or burning or by completely plowing under. This cuts off the breeding of the weevil and reduces by millions the number of weevils that live through the winter to attack the following year's crop. If the farmers would uniformly follow this recommendation the weevil problem would be solved.

Be Informed

Bulletins on boll weevil control can be obtained free by applying to either the State Plant Board or the University of Florida Experiment Station at Gainesville, Florida.

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*..*Editor*

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QUARANTINE DEPARTMENT

QUARANTINE INSPECTOR'S QUARTERLY REPORT FOR QUARTER ENDING DECEMBER 31ST, 1923

SHIPS AND VESSELS INSPECTED:			
From Foreign Ports	552		
From U. S. Ports other than Florida	408		
From Florida Ports	195		
Total		1,155	
NUMBER OF PARCELS INSPECTED:			
Arriving by water:			
Passed	156,380		
Treated and passed	25,815		
Returned to shipper	280		
Contraband destroyed	541		
Total			183,016
Arriving by land—express, freight, wagon, etc.:			
Passed	1,450½		
Treated and passed	1,380		
Returned to shipper	62½		
Contraband destroyed	885		
Total			3,778
Arriving by mail:			
Passed	420		
Treated and passed	10		
Returned to shipper	27½		
Contraband destroyed	1½		
Total			459
GRAND TOTAL OF PARCELS INSPECTED			187,253
Number of parcels on hand pending determination as to final disposition	64		

Principal Pests Intercepted During the Quarter Ending December 31, 1923

Insect	From	No. shipments intercepted
Blackfly egg spiral	Bahamas	1
Chionaspis salicis (Linn.)	England	1
Lecanium viridis (Green)	Cuba	1
Stellate scale	Bahamas	1
Black scale	Cuba	1
Spruce cone gall	Germany	1

Number of Packages of Fruits and Vegetables Fumigated at Florida Ports from Oct. 1, to Dec. 31, 1923

Key West	17,141
Pt. Tampa	16,824
Miami	104
Total	34,069

DEPARTMENT OF CITRUS CANKER ERADICATION

Report on Eradication Work in Cooperation with the Bureau of Plant Industry, U. S. Dept. of Agri., for Quarter Ending December 31, 1923

Citrus grove trees inspected	904,870
Citrus nursery trees inspected	43,362,562
Inspectors employed on canker eradication	31
New properties showing active infection	0
Total properties showing active infection	1
Grove trees found infected	1
Nursery trees found infected	0
Counties in which active infections were found	1

General Summary

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	15,151
Nursery trees found infected since May, 1914	342,260
Number properties found infected to December, 1923	510
Properties declared no longer "Danger centers"	499
Properties still classed as infected December 31, 1923	11

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to December 31, 1923:

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Jan.	....	306	86	14	0	0	0	0	0	1
Feb.	....	165	21	4	1	0	0	0	0	1
Mar.	....	444	49	9	1	1	0	0	0	2
Apr.	....	408	49	169	2	1	0	0	0	3
May	108	1042	338	52	1	1	0	0	585	2
Jun.	160	772	450	45	10	0	0	0	168	1
July	275	651	349	39	0	0	539	0	28	0
Aug.	1313	1345	219	30	0	1	1	0	34	0
Sep.	767	618	124	6	0	0	0	0	23	0
Oct.	565	214	451	2	0	0	0	0	19	1
Nov.	773	494	131	1	0	0	0	0	12	0
Dec.	366	256	27	1	0	0	0	0	4	0
Total	4327	6715	2294	372	15	4	540	0	873	11

BEE DISEASE ERADICATION

Quarterly Report for Period Ending December 31, 1923

Number of apiaries inspected	51
Number of colonies inspected	2,826
Number of apiaries infected with American foul brood	0
Number of colonies infected with American Foul Brood	0
Number of apiaries infected with European Foul Brood	0
Number of colonies infected with European Foul Brood	0

VARYING OPINIONS CONCERNING A PEST

Protecting an industry is often a very thankless task. Those whose plans you thwart (for the public good) almost invariably register a strong protest and often try to "start something". Those who are being protected pursue the even tenor of their ways unconscious of the fact that they are being protected by any one.

The State Plant Board has adopted some very reasonable rules and regulations governing the bringing of plants into this state. It is the aim of these rules and regulations to protect Florida's plant life and incidentally all of those who directly or indirectly are benefited thereby. This is another way of saying "Every Florida citizen and some others who have investments here".

Such rules interfere with some nurseries' plans to send plants into the state, for you can give no protection without interfering with something that is being done. The nursery interfered with generally writes to the prospective customer in Florida representing that the Plant Board is a very arbitrary organization, adopting wholly unnecessary rules which prevent said firm from shipping its stock to Florida points, and of course its stock is perfectly safe. Come to think of it, you could hardly conceive of a nursery admitting that its stock was dangerous, could you?

Numerous instances could be cited; we will mention but one which is highly typical. An extremely serious insect pest known as the Japanese Beetle was imported into the Riverton, New Jersey, section, supposedly in soil around the roots of Japanese iris bulbs. It is now well established all around Philadelphia and environs. The grub of this insect lives in the soil, feeding on the roots of plants and often doing great damage. The adult is a general feeder and will eat the leaves of almost any tree or vine. It will eat holes into fruit and in some cases will eat practically all of the apple, leaving only the core hanging on the tree, and all of a peach, leaving only the pit. To prevent the entrance of this

insect, Florida, among other States, has been forced to pass a rule to which some nurserymen in the infested area take exception.

In writing to a Florida customer the president of the nursery which is credited with having introduced the Japanese Beetle has the following to say: "The orchards in the infested area are bearing just as heavy crops of fruit as the same class of stock outside of the area where the Japanese Beetle is not known, and while you will find now and then an apple tree or a peach tree on which damage is done to the fruit, we are satisfied that greater damage is done every year by the common ordinary Rose Bug than by the Japanese Beetle."

Let us contrast with this statement one prepared by the scientist in charge of the Japanese Beetle project for the United States Government and issued over the signature of C. L. Marlatt, Chairman of the Federal Horticultural Board. Surely such a statement would be both disinterested and conservative. It follows: "The beetle population, in the territory which has been infested for several years, has remained undiminished; and during the autumn of 1923, the larvae have been found as numerous as 1500 to the measured square yard of sod, while in 1922, the highest number of larvae recorded was 1038 to a square yard. * * To illustrate how abundant the beetles were during July; in an orchard of 156 ten-year old Red-bird peach trees, 13 sixteen-gallon tubfuls of beetles were shaken from the trees and collected early one morning, in somewhat less than two hours. The next morning the beetles were apparently as numerous on these trees as before."
—F. M. O'B.

THE QUARTERLY BULLETIN

State Plant Board of Florida

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GENERAL INFORMATION FOR BEEKEEPERS

By

J. C. Goodwin

Apiary Inspector

Queen Bees

Queens of the several different races of bees are reared by a considerable number of queen-breeders or specialists in the rearing of queens. The large number of men engaged in queen rearing for the market precludes giving anything like a complete list, and the beekeeper intending to purchase queens can best consult the advertisements of queen breeders in any of the periodical publications devoted to beekeeping, a list of which is given below. The prices for queens range all the way from seventy-five cents for untested queens to twenty-five dollars for an extra select breeder. The price is also variable with the breed, strain, time of year, quantity ordered, etc.

Cut Weeds and Grass in Front of the Hive

Weeds and grass should be kept down in front of the beehives at all times so as to afford the bees unrestricted opportunity to come and go in their work of gathering honey.

Suppose the entrance to a large office building were obstructed with a cane-brake. How much would the work and efficiency of the inmates be interfered with? Yet there are in a beehive many times more workers than in any office building in the United States and the majority of them must pass in and out of the doorway many times a day. Where the bees are compelled to work their way through a tangled thicket of grass or weeds the aggregate amount of time lost makes a decided difference in the amount of honey which a colony can store. Owing to variation in the blooming periods of honey-producing plants, nectar is available for the bees at irregular intervals; hence the importance of causing as little interference as possible with the work of gathering it.

Vegetation about the entrance also impedes proper ventilation of the hive and this in turn handicaps the bees in building new comb in which to store the honey and in the proper ripening of

the honey, the latter being largely a process of drying or removing the excess moisture from the nectar gathered in the field.

Weeds and grass also afford protection for spiders and other predaceous insects which capture and destroy many of the busy workers. Keep the entrance way clear and give the bees opportunity to do their very best in gathering honey for you.

Robbing

If bits of honey be dropped about the apiary during a period when there is no honey flow on, or left where bees can obtain access to same, it will usually start what is termed "robbing". The bees finding this honey will gather it up and carry it away to their respective hives. When this free supply is exhausted they will greedily search for more, and if none is found may attack some adjacent hive. If the colony in the latter case is weak, the invaders will conquer, kill a majority of the rightful occupants, destroy the brood, carry off the honey and tear up the combs. If the attacked colony is strong a pitched battle ensues, the results of which will be hundreds of dead bees on both sides, even though the robbers be repulsed. Once in the habit of robbing, it may be kept up for days or even weeks by these colonies which have become addicted to the habit, making it impossible to open a hive in the yard without the robbers immediately plunging in and starting trouble. For this reason no honey should ever be left exposed, and, during a dearth of honey, hives should not be kept open longer than is absolutely necessary. When robbing has once started, the entrances of all adjacent hives, and especially of the hives being attacked, should be closed down to a small aperture and all work immediately discontinued in the apiary. Grass, weeds or Spanish moss thrown over the entrance of the hives will materially assist in overcoming the robbing by retarding the invaders when they try to gain entrance. The robbers are unable to enter the hive through the barrier in large numbers and the "guards on duty" are able to kill the robbers off. The grass or moss will afford the bees ventilation during the fight. Sprinkling the front of the hive being attacked with water and carbolic acid will also prove helpful in driving away the robbers.

Bees Require Shade

One of the most important points in securing the maximum production of honey by a colony of bees is in seeing that the beehive is properly shaded and protected from the hot sun. One

might not suppose that the matter of shade could affect the amount of honey produced by a colony of bees, but such is the case.

In the first place, the bees make their combs out of wax, the melting point of which is comparatively low, and when the beehive is exposed to the direct rays of the sun in mid-summer the combs frequently melt down, causing melted wax and unsealed honey to run over the combs and young bees in the hive and requiring many hours of hard work on the part of the bees to "clean up the mess". This time would otherwise be spent by the bees in gathering honey.

For the production of wax for comb building a certain temperature is necessary within the hive and in order to prevent the temperature going too high during warm weather the bees ventilate the interior of the hive by forcing currents of air between the combs. This air is moved by the bees standing on the combs, floor or entrance, as the case may be, and rapidly vibrating their wings. The higher the outside temperature the greater the number of bees which must devote their time to ventilating the hive. This takes just that many workers from the task of gathering and storing honey.

The best location for a hive of bees or for an apiary is in a well-drained, shady place where there is a good circulation of air from chance breezes. DENSE SHADE OR MOIST LOCATIONS should be avoided. If it is necessary to have the beehives in the open where the shade of trees is not available, the beekeeper can readily provide a "shade-board." This can be made of any rough material, the only requirement being that it be large enough to shade the top and sides of the hive during the hot part of the day. If boards are used, do not place them directly on the top of the hive because it will afford a harboring place for ants. Place blocks of wood under the corners and hold the boards at least an inch above the cover. In the absence of boards for making a shade, brush may be used.

During the summer months care should be taken by the beekeeper to see that there is ample entrance room to the hive so that the bees can secure sufficient ventilation at all times. The interior of the hive is much like the interior of a busy office building, in that plenty of fresh air is necessary to the health and efficiency of the inmates.

An ample supply of fresh water should be available for the bees, especially during brood rearing. This should be considered

when starting an apiary and the yard placed within reach of water.

Attention to small details will, in many cases, result in several more pounds of honey being produced by each colony of bees than would otherwise be the case. Proper ventilation and shading also tend to prevent excessive swarming.

Transferring Bees to Frame Hives

There are several methods of transferring bees from box hives into modern frame hives, or "patent gums", as they are sometimes called. The method selected will depend largely on the preference of the individual beekeeper. (See Farmers' Bulletin 961 on transferring bees.) The "A B C & X Y Z of Bee Culture", a well known book on beekeeping, gives the following directions for transferring:

> "We will assume that your hive, or hives, have been received in the flat, are put together and painted, and contain frames of wired foundation ready for the bees. Light your smoker and put on your bee veil. Move the old hive back four or five feet, and put the new hive in its place. Prepare a small box about eight inches deep, and one side open, that will just cover (NOT SLIP OVER) the bottom of the box-hive. Turn the beehive upside down; set the hiving box over it, and then drum on the sides of the hive with a couple of sticks until about two-thirds of the bees pass up into the box. Gently lift off the box containing the bees, and dump it in front of the entrance to the new hive. Make sure the queen is among them by watching for her as she passes with the rest into the hive. If you do not discover her, look inside the hive. If you still fail to find her, drum out bees from the old hive again until you do get her, for, to make the plan a success, she must be in the new hive. Return to the box hive and turn it right side up and set it down a couple of feet back of the new hive, with its entrance turned at right angles. You now have in the hive about one-third of the original colony, the combs and all the brood. Allow the old hive to stand for at least twenty-one days at the end of which time the brood will be hatched out, with the exception of a little drone brood, which will be of no value. Turn the hive upside down and drum the bees out again into the hiving box, after which dump it in front of the new hive as before. If the queen in the new hive is the one you wish to keep, put an entrance guard over the entrance to catch the young queen hatching in the meantime in the old hive, for she would go in and one or the other would be destroyed. If there is no choice of queens, let the second drive of bees go in and the queens will fight it out. Your job of transferring is now complete, and all you have on hand is an old box containing a lot of crooked combs, with perhaps a little honey and drone brood in it. The honey can be extracted, or used for chunk honey on the table, if fit for use."

Experienced beekeepers generally use a method somewhat different from the above, involving, perhaps, a little more work, and resulting in more stings, but offering the advantage of getting

the transferring work over in a short time and without any further attention being required. The method is as follows:

Bee veil, smoker, new hive, frames, chisel, hammer and a long knife (butcher knife) are required. Plenty of smoke is first blown into the entrance of the box hive. The latter is then removed from the stand and the new hive placed in its stead, with entrance facing in the same direction. The top or side of the box hive is then pried off with the chisel, exposing the combs on the inside. Plenty of smoke is used to keep the bees under control and to drive them off the combs as the latter are removed. The combs are cut out one at a time, and the bees brushed off them onto the ground in front of the new hive. For this purpose a bee brush is very handy.

All parts of comb containing either sealed or open honey are cut out and placed in a pan or bucket to be fed back to the bees at some future time. If desired, or suitable, the sealed honey may be kept for table use. The combs containing brood are cut to fit into the frames of the new hives. These pieces of brood-comb are fastened into the frames by winding white, soft, cotton cord around the frame several times, from top to bottom, so that the comb is held firmly in place. These frames of brood are then placed in the new hive, and the bees immediately begin clustering on them. In placing this comb in the frame, care should be taken to have the same edge of the comb upward that was upward in the box hive. After the honey and brood have been disposed of as above, any bees remaining are shaken down in front of the new hive and allowed to go in.

Usually enough brood comb is obtained from a box hive to fill three or four frames in the new hive. The balance of the frames in the new hive should have sheets of foundation (preferably full sized sheets) placed in them, with the frames wired and these frames placed in the new hive along with the brood comb.

If it is desired to feed the honey back to the bees in the new hive—and this is necessary if the transferring is done at a season when the bees are not gathering honey from the fields—this can be done readily by placing an extra super (without any frames in it) on the hive, this super separated from the brood chamber by a honey-board or super-cover with a half-inch hole in it. A plate or tray of the honey is then placed in the super and the bees, coming up through the hole from the main part of the hive, take the honey down to the brood-chamber. As rapidly as the plate or "feeder" is emptied by the bees, it can be refilled and the feeding thus continued until the colony has stored up enough of the honey to last until the next honey flow or over winter.

About a week or ten days after the date of transferring, the hive should be opened, and if the brood-comb has been securely fastened to the top and ends of frames the cotton cords should be removed. These should be left on the frames, however, until the comb is securely fastened in place.

Transferring colonies from bee trees is not particularly different from the process described above, except that one must first cut down the tree and then get at the hollow containing the

bees by a combination of sawing and chopping until the combs are made accessible. They are then cut out and secured in the frame hive as above described. It is a good idea to leave the new hive for a few days at the point where the tree was cut open. This not only gives the bees time to fasten the combs in the frames before they are moved, but allows all the bees to find the hive and get accustomed to going in and out of it.

DISEASES

For the information of beekeepers who are not familiar with the more serious bee diseases we give a brief description of them. Of these, American foul brood is the most deadly and destructive. A colony of bees affected with this disease never recovers but is totally destroyed within a short period.

Whenever the presence of disease is suspected in your apiary, communicate with the State Plant Board, Apiary Inspection Department, Gainesville, Florida. When possible, a trained inspector will be sent to investigate the case and give you expert advice, all without charge. When this cannot be done you will be given instructions as to how to safely send material for examination and diagnosis.

DO NOT SEND SAMPLES OF DISEASED BROOD without FIRST writing us and securing proper instructions for preparing the sample and package. By doing otherwise you may yourself be responsible for spreading disease to apiaries of others.

AMERICAN FOUL BROOD

American foul brood usually manifests itself about the time the young larvae cease feeding and pupation has begun. It is an infectious disease, caused by an organism known as *Bacillus larvae*. The first indication of infection is a slight brownish discoloration and the loss of the rounded appearance of the healthy larvae. The larvae slowly settle down on the lower side of the cells and become light chocolate brown in color. As the larvae gradually melt down they take on a darker color and finally become dark brown scales on the lower wall of the cells. If a toothpick or small stick is inserted in the brown decaying mass and slowly withdrawn, some of the larval remains adhere to it and draw out into a thread. This ropiness is one of the characteristics in diagnosing the disease. The dead brood usually gives off a characteristic and usually penetrating odor, similar to that of heated glue. Scattered sunken cells, usually perforated, left over

after the healthy brood has emerged, together with the glue pot odor and characteristic ropiness, strongly indicate the presence of the disease.

The treatment of an infectious bee disease consists in the entire elimination and destruction of the cause of the disease. In treating American foul brood the object is to remove and destroy all contaminated materials. The common means of disseminating the germs is in the contaminated honey from infected colonies. The spores of the disease may remain virulent in infected honey for several years. For that reason, when handling an infected or diseased colony, the operator should exercise every precaution not to scatter any honey in the vicinity of the apiary, as A LITTLE CARELESSNESS IN THE HANDLING OF INFECTED MATERIAL MAY MEAN THE LOSS OF THE ENTIRE YARD.

The shaking treatment consists in the removal and destruction of all infected materials from the colony and compelling the bees to build new combs and gather new stores. This is done by shaking the bees from the infected combs into a clean hive, containing new frames with INCH STARTERS for foundation. The operation should be repeated within 48 hours, using full sheets of foundation instead of the narrow strips. All new combs constructed and honey stored should be DESTROYED.

It is advisable to cage the queen for a couple of days, in the new hive, to prevent the colony from absconding.

It is urgently requested when disease is suspected or found that the beekeeper immediately communicate with the State Plant Board, Apiary Inspection Department, Gainesville, Florida.

The shaking treatment is NOT TO BE RECOMMENDED where a relatively small number of colonies are infected. The risk of bees from healthy colonies getting some of the infected honey during the manipulation much more than offsets any possible gain due to successful treatment.

When disease is found, all entrances of diseased colonies should be immediately closed to a small aperture to prevent robbing. Then, just after dark, kill the bees in the infected colony and burn them, together with all frames, brood, honey, etc., in a pit not less than three feet deep. Afterwards, and before daylight, fill in the pit with dirt. All hive bodies, supers, covers and bottom boards should be saturated with kerosene and

ignited so as to destroy all propolis, wax, honey and other infected material on them. The use of the burning oil spray for disinfecting the bodies, supers, covers and bottom boards has been found very effective. The hands, smoker, hive tool and other equipment used when handling the infected colony should be disinfected in a 1:1000 solution of bichloride of mercury.

Under Florida conditions the only safe course to follow is to destroy the entire contents of the infected colony, as described above. District Apiary Inspectors of the State Plant Board, where available, will render assistance in such work to the beekeeper without charge.

European Foul Brood

This disease attacks the larva while it is still curled up on the base of the cell. The earliest indication of the disease is a slight yellowish or gray discoloration of the larva which at the same time moves about uneasily in its cell. After death, the larva usually falls away from the base of the cell, losing its rounded appearance and becoming translucent (partially transparent). Later it changes to a moist, collapsed mass having the appearance of being melted. Larvae that have been dead of this disease for a considerable time not infrequently show a slight granular ropiness; less pronounced, however, than in the case of American foul brood. The final remains of the dead larvae are grayish-brown scales against the bottom of the cells or shapeless masses on the lower side walls. The dead larvae, however, usually do not have a characteristic odor like American foul brood but sometimes, in severe cases, a sour odor, similar to yeast fermentation, may be present. This disease attacks drone and queen larvae almost as quickly as those of the workers.

The first requisite in the treatment of European foul brood is to have a strong colony. If the colony is depleted of bees to any great extent, it is well, before proceeding to treat, to strengthen it by giving brood or young bees, or both, from healthy colonies, or by uniting diseased colonies. The treatment requires the removal of the queen, keeping the colony queenless for from ten to twenty days, and then introducing a young, vigorous queen of the best Italian stock. In the meantime the bees cleanse the cells of the diseased brood, in anticipation of the queen needing room when she starts laying, and the colony usually overcomes the disease.

Sacbrood

When larvae are attacked by this disease they die about the time of pupation or shortly after being capped over, usually lying on their backs with their heads turned upward. In advanced stages the color varies from light yellow or light brown. The body becomes swollen, the contents watery and the heads black and hard. In bad cases a very sour odor is present, not unlike that of vinegar.

When the infection is relatively light, treatment is, as a rule, not necessary, the disease disappearing of its own accord, especially if the bees are securing an abundance of new honey.

In rather bad cases it is advisable to apply the same treatment as for European foul brood, namely, to make the colonies queenless for about a week and then requeen with young Italian queens from healthy stock. In such cases, also, weak colonies should be united so as to have only strong colonies in the yard.

In extremely severe cases it may be necessary to destroy the infected brood and combs and place the colony on clean combs or foundation.

As sacbrood is an infectious disease, pains should be taken not to move any bees or equipment from affected apiaries to others and working tools, clothing and hands should be well disinfected after working with diseased colonies.

Starved or Chilled Brood

A complete absence of honey or pollen, or both, of course results in the death of unsealed larvae or brood by starvation. The first indications of starvation are the total absence of all honey in the hive and the dragging out of brood from the hive by the workers. Within the hive starving larvae often work their way out of the cells and fall to the bottom board where they may, or may not be carried out by the workers. Young brood which has died of starvation very quickly turns black.

Too large an entrance in cold weather, particularly in the case of weak colonies, may result in both sealed and unsealed brood being killed. Such brood, if not promptly removed by the bees, turns dark and may have an odor of decay, more or less "sour," but such larvae do not have the "glue" odor or ropiness characteristic of American foul brood.

Paralysis

This trouble, unlike the diseases mentioned above, attacks only the mature bees. The abdomen becomes distended and the

bees crawl about, trembling as if partially paralyzed and appear to be in great misery. This condition often ceases in a few days, but occasionally affected colonies lose so many bees that they become worthless for several weeks. Sometimes the queen contracts the disease and dies. Since the cause of this disease is not known, we are not in a position to recommend any particular treatment. One of the most frequent recommendations is that of killing the queen in the affected hive and requeening with a young queen from a healthy colony. This treatment is based on the idea that the trouble is an inherited one from the mother queen or due to to some constitutional weakness on the part of the queen. Some strains are much more subject to this trouble than others.

Enemies of Bees

Wax Worms

The wax worm is the larva of a small, light gray moth that lays its eggs in beehives or on combs wherever it can find them. The "worms" hatching from these eggs develop very rapidly and are able to destroy a complete comb in a few days time. Black bees, weak colonies or queenless colonies are most susceptible to invasion by this pest. The best preventive lies in keeping bees only in frame hives, with straight combs and no place where the worms can seek refuge from the bees, together with keeping only Italian bees and keeping the colonies strong at all times. Strong Italian colonies will take care of this problem themselves. The beekeeper should not allow combs or vacant hives, with combs in them, to remain on his premises as a breeding place for this pest. The worms may be destroyed in combs kept in storage by fumigating with carbon bisulphide, directions for which operation we will gladly furnish on request.

Ants

Ants sometimes make a great deal of trouble for both the bees and the beekeeper. A tiny dark brown ant attempts to take honey from the hive, while the small black "fire ant" takes both honey and brood. A giant red and black "wood ant" attacks both the bees and brood and may destroy a colony of bees in a couple of days time. The large ant does its damage at night, and it is necessary to look the yard over every night or so if the ants are causing trouble. It usually builds its nest under a board, old hive cover, in palmetto brush, etc.

If the colony from which the ants come can be located the best plan is to pour boiling water or gasoline on the ants and burn up their hiding place. If the nest is in the ground, the best plan is to punch a hole near the entrance of the nest with a sharp stick and pour in from one to four ounces of carbon bisulphide and close the openings by throwing wet earth over them. The gas formed by the carbon bisulphide is heavier than air and will permeate the ground, the wet earth forming a blanket over the surface. If the nest cannot be located it may be necessary to place the beehives on stands, the legs of which rest in cans of water, or, in extreme cases, dig a trench around the yard and form a water barrier between the apiary and the ants. When all remedies fail, the yard will have to be moved to another location.

Miscellaneous

Toad frogs, birds, mice, skunks, dragon flies, coons and bear also cause annoyance and, at times, loss to the beekeeper. There are no set remedies recommended for these pests. The apiarist must work out his own methods of repelling the pests.

Old and failing queens are often to blame for weak colonies. When the brood is found scattered here and there, in patches, and the colony is dwindling down, it is a sure indication that the queen should be replaced by a young one. In the State of Florida the colonies should, as a usual thing, be requeened every other year, sooner if the queen shows any signs of failing.

Special questions pertaining to any difficulties which you may encounter in beekeeping work in Florida will be cheerfully answered by Dr. Wilmon Newell, J. C. Goodwin or Frank Stirling of the Plant Board staff, Gainesville, Florida. No charge is made for such service.

Literature on Beekeeping

The following bulletins on beekeeping may be obtained upon application to the Honorable Secretary of Agriculture, Washington, D. C., or the State Plant Board, Gainesville, Fla.

Farmers' Bulletin 447, BEES
Farmers' Bulletin 503, COMB HONEY
Farmers' Bulletin 653, HONEY AND ITS USES
Farmers' Bulletin 695, OUTDOOR WINTERING OF BEES
Farmers' Bulletin 961, TRANSFERRING
Farmers' Bulletin 1039, COMB HONEY PRODUCTION
Farmers' Bulletin 1198, SWARM CONTROL

There are published in this country several periodical magazines devoted to beekeeping. Sample copies of these publications may be obtained by addressing the publishers. Following are the principal journals and their postoffices of publication:

American Bee Journal, Hamilton, Illinois
Gleanings in Bee Culture, Medina, Ohio
Western Honey Bee, 121 Temple St., Los Angeles, California
Beekeeper's Item, New Braunfels, Texas
Beekeepers' Review, Lansing, Michigan
Dixie Beekeeper, Waycross, Georgia

There are also a number of valuable text books which are very useful alike to the beginner in beekeeping and the experienced apiarist. Among these may be mentioned:

Queen Rearing Simplified, Jay Smith
A B C & X Y Z of Bee Culture, A. I. & E. R. Root
Beekeeping, E. F. Phillips
Langstroth on the Hive and Honey Bee, revised by C. P. Dadant
Fifty Years Among the Bees, C. C. Miller
Advanced Bee Culture, W. Z. Hutchinson
Productive Beekeeping, F. C. Pellett
First Lessons in Beekeeping, C. P. Dadant
Scientific Queen Rearing, G. M. Doolittle
One Thousand Answers to Beekeeping Questions, C. C. Miller
American Honey Plants, F. C. Pellett
Beekeeping in the South, Kennith Hawkins
Practical Queen Rearing—F. C. Pellett

These text-books may be purchased through any dealer in beekeeping supplies. If they cannot supply you, we will send you the name and address of the publisher upon application.

The Florida Bee Law and rules of the Board pursuant thereto, and a small booklet on Florida Honey Plants may be had by addressing the State Plant Board, Gainesville, Florida.

Dealers in Beekeeping Supplies

The following are manufacturers of, or dealers in, bee hives, veils, smokers, wax foundation, etc., and most, or all, will furnish illustrated catalogues on request. These catalogues frequently contain interesting and useful information, particularly regarding beekeeping equipment:

A. I. Root Company, Medina, Ohio
F. W. Muth Co., 204 Walnut St. Cincinnati, Ohio
C. H. W. Weber & Co., 2146 Central Ave., Cincinnati, Ohio
Dadant & Sons, Hamilton, Illinois
G. B. Lewis Co., Watertown, Wisconsin
Hoffman & Hauck, Inc., Woodhaven, New York
W. T. Falconer, Falconer, New York
Crenshaw Bros. Seed Co., Tampa, Florida
J. J. Wilder, Waycross, Georgia

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

AN APPRECIATED ACTION

The Florida State Horticultural Society in annual session at Tampa April 22 to 25 inc., received and accepted the report of its Committee on Plant Quarantine. This report was so commendatory of the work of the State Plant Board, and at the same time constructively critical, that we are printing it herewith.

REPORT OF THE COMMITTEE ON PLANT QUARANTINE STATE HORTICULTURAL SOCIETY, APRIL 22-25, 1924

Your committee, having been only recently named and being a new committee, has been somewhat at a loss as to the nature of the duties it is expected to perform. In the absence of any precedent for a report of this kind to the society from a standing committee, we have assumed that our duties consist of studying the measures, both federal and state, which are intended to afford protection against the introduction into or the spread within the state of dangerous plant pests and of the methods made use of in applying these measures; also to offer criticisms of a constructive nature and suggestions for the betterment of the protective service.

With this conception of our duties, your committee has investigated, as well as it could, the general plant quarantine

situation. This is a subject of such magnitude and of so great importance to the horticulturists that it is deserving of more than passing attention. The endeavor of the committee has been to ascertain the essential facts of the situation and to present this information to the society as briefly as possible.

We find that protective measures are of both state and federal origin. The federal protection is through the activities of the Federal Horticultural Board, while the State Plant Board functions for the state. The activities of each organization are of both an external and internal nature; that is, foreign and domestic. The domestic measures also are of two kinds: those which apply to interstate movements and those which are intrastate. The nature of the protective measures may be classified as (a) regulatory or restrictive and (b) prohibitive or exclusive.

The scope of both the federal and state laws is such as to permit the rules and regulations of these organizations to apply to all plants, plant products and other materials which might serve as carriers of plant pests.

Your committee is pleased to report that the plant quarantine authorities appear to be functioning zealously and efficiently. The limitations are traceable to inadequacy of financial resources. This is particularly so, in our judgment, with respect to the Federal Horticultural Board and, in our own state, to the work of the Nursery Inspection Department of the State Plant Board.

With respect to the Federal Horticultural Board's activities, your committee finds that all exposed ports of entry are not guarded by inspectors and at some ports the force of inspectors is insufficient. The committee recommends that the society take cognizance of this and again request the representatives of Florida in the Congress to support the requests of the Secretary of Agriculture for appropriations for the uses of the Federal Horticultural Board.

Your committee has had opportunity to observe the work of the State Plant Board and of its several departments operating under the direction of the Plant Commissioner. Much of the information upon which this report is based has been secured from officials of the Board, although members of the committee have had opportunity to make personal observations. We feel that the State Plant Board is to be commended for its faithful efforts to protect our horticultural industries and is entitled to a continuation of the unstinted support of the society.

It occurs to the committee that the outstanding feature of the past year's quarantine work has been the promulgation, by the Federal Horticultural Board, of its Quarantine No. 56, which prohibits absolutely the importation into this country of certain fruits and vegetables from foreign countries and allows introduction of certain other fruits only under permit. This Quarantine 56 is a companion quarantine to the Board's Quarantine No. 37, promulgated several years ago, which applies to importations of plants. The provisions of Quarantines 37 and 56 of the Federal Horticultural Board are in line with similar provisions of the State Plant Board of Florida and these federal quarantines, as well as all other federal quarantine or restrictive orders, are applied in Florida by inspectors of the State Plant Board.

Grove Inspection and Citrus Canker Eradication

In our search for information we have learned that the grove inspection and citrus canker eradication work in the State of Florida is in a satisfactory condition. The Plant Board forces engaged in this work have completed another general survey of the citrus plantings of the state without discovering any additional foci of citrus canker infection. The situation at Davie is good. Only four infected trees have been located there during the past year, the last one in October, 1923. No other infected trees have been found in any portion of the state.

The committee is of the opinion that the citrus acreage of the state should be under constant patrol and that sufficient inspectors be engaged in this work to allow complete inspection once in every two years.

Quarantine Service

The various ports of entry of the state are manned by a force which is at present adequate to meet the demands. With increase of commerce, however, this will not be the case. The State Plant Board inspectors, who are also collaborators of the Federal Horticultural Board and apply the rules and regulations of the federal government, board and inspect annually some 5,000 vessels arriving at Florida ports. Thousands of packages of horticultural products are inspected or fumigated, or both, and the baggage of thousands of passengers is inspected in conjunction with customs officials.

Your committee believes that the inspection service along the northern border and the parcel post inspection service can and should be strengthened.

Nursery Inspection

Your committee finds that the nursery inspection work is well planned and efficiently conducted. The inspections, as made, are thorough and the system of record keeping is complete. It is with regret, however, that we report that the frequency with which inspections of nurseries is made is insufficient, under the conditions which prevail in Florida, to afford the purchaser of nursery stock the degree of protection to which he is entitled. It is the opinion of the Plant Board officials, in which this committee concurs, that certainly at least three inspections per annum should be made of all nurseries in the state. This is not being done, owing to the limited number of men engaged in the work and the greatly increased number of nurseries with correspondingly increased acreage. We have found that between 1916 and 1921 the number of nurseries under inspection varied from 2500 to 3,000, with not over 2500 acres; whereas in 1923 the Nursery Inspection Department had under observation 3700 nurseries, with 4700 acres, and no increase in the number of inspectors.

Another interesting bit of information obtained from the Nursery Inspector's records is the extent of the movement of citrus nursery stock since 1916, shown as follows:

1916	1,043,410
1921	5,990,160
1923	7,619,657

Recommendations

Your committee recommends that the society continue its policy of supporting the Plant Board and that the legislative committee make every effort to secure adequate appropriations for the continuance of the work of the Board. It is especially urged that efforts be made to have increased appropriations available for much-needed expansion in the Nursery Inspection Department.

Respectfully submitted,

CLEVE F. SMITH,

Chairman.

A NEW APHID ATTACKING CITRUS

Citrus growers as well as entomologists are much concerned over the appearance of a new aphid in the citrus groves of Florida. State and Federal specialists have been making investigations throughout the state. The Florida State Horticultural Society at its meeting in April appointed a special committee to consider the situation. This committee met with the specialists and has issued a report with recommendations. A portion of the report is published herewith:

> In so far as is known this is an entirely new species of aphid, that has not infested citrus trees in Florida here-to-fore. Every indication points to its being an introduced species from some foreign country. Every effort is being put forth to discover its origin and to identify it.
>
> In the counties of Pinellas, Hillsborough, and Polk it has done a great amount of damage to the foliage and fruit of both old and young trees. In some cases it has killed small trees outright. This is not all of the story, for the insect has been spreading rapidly and now covers practically the entire citrus belt of South Florida. In the areas recently infested the insects are still scarce and unnoticed by the growers but it is the opinion of the entomologists that the insect will prove just as destructive in these areas as in the sections where they have been present for several weeks. The insect attacks the young growth particularly and the leaves are seriously curled. After the leaves are half grown the insect ordinarily leaves them. In some cases the injury to the fruit is so severe that little bumps or protuberances cover the entire rind. In many instances a large part of the fruit has already fallen from the trees. There is a question in the minds of the growers whether the injured fruit outgrows the rough spots on the fruit caused by the new species of aphid.
>
> ### Host Plants
>
> This aphid has been found to infest all varieties of Citrus but is especially injurious to varieties of the Mandarin family. It is next injurious to the sweet orange and lastly to the grapefruit. It has been found on Loquats, Night Shade, Mexican Rose, Jerusalem Oak, Milk Weed, Dogfennel and Cudweed.
>
> ### Parasites and Predacious Enemies
>
> Thus far the most important predacious enemies to this pest are four species of Lady Beetle, Syrphus Fly larvae and Lace Wing Fly larvae. While these do a great deal of good so far they have not been able to control the pest because of lack of numbers. Thus far none of the wasp-like parasites which are effective in controlling other aphids have been found to attack this new aphid to any appreciable extent. Experiments with various methods of killing the aphid have been carried on persistently and in the most energetic way ever since the pest was recognized as a new insect, this work having been done by the Bureau of Entomology and by the Florida Experiment Station, with the result that a number of treatments have been found to give a very high percentage of mortality among the aphids. The most effective method of control so far seems to be that of dusting the trees. For this purpose tobacco extract and tobacco dust have been used effectively. The Calcium Cyanide is effective when used in tents. Various spray solutions of tobacco extract, oil emulsion, soaps, etc. are very effective

in killing all insect pests reached but does not get into the curled leaves as well as the dust. Oil emulsions usually used for White Fly and Scale insects are very effective in killing this pest when used at the same dilution as for the other insects. Lime Sulphur solution as ordinarily used for killing Rust Mite is also very effective if Nicotine Sulphate is added 1 to 800. It is suggested that nicotine dust be added to the dust used in controlling Rust Mites. At the present time the aphids are distributed irregularly over the groves, being confined mostly to the trees which are showing the June flush of growth. It is urged that growers spot dust or spray their groves by giving special attention to these infested trees. It is felt that by this method, the numbers which will later attack the June growth will be greatly reduced. In groves where active means have been taken to combat this insect it is evident that much new growth has been saved.

DEPARTMENT OF CITRUS CANKER ERADICATION

Report on Eradication Work in Cooperation With the Bureau of Plant Industry, U. S. Dept. of Agri., for Quarter Ending March 31, 1924

Citrus grove trees inspected	336,351
Citrus nursery trees inspected	32,194,703
Inspectors employed (entire Plant Board force)	89
Inspectors employed on canker eradication	29
New properties showing active infection	0
Total properties showing active infection	0
Grove trees found infected	0
Nursery trees found infected	0
Counties in which active infections were found	0

General Summary

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	15,151
Nursery trees found infected since May, 1914	342,260
Number properties found infected to March 31, 1924	510
Properties declared no longer "Danger centers"	501
Properties still classed as infected March 31, 1924	9

Department of Citrus Canker Eradication (Report Continued)

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to March 31, 1924:

1914		1915		1916		1917		1918		1919		1920		1921		1922		1923		1924	
Jan.		Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0	Jan.	0	Jan.	0	Jan.	0	Jan.	1	Jan.	0
Feb.		Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0	Feb.	0	Feb.	0	Feb.	0	Feb.	1	Feb.	0
Mar.		Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1	Mar.	0	Mar.	0	Mar.	0	Mar.	2	Mar.	0
Apr.		Apr.	408	Apr.	49	Apr.	169	Apr.	2	Apr.	1	Apr.	0	Apr.	0	Apr.	0	Apr.	3		
May	108	May	1042	May	338	May	52	May	1	May	1	May	0	May	0	May	585	May	2		
Jun.	160	Jun.	772	Jun.	450	Jun.	45	Jun.	10	June	0	June	0	June	0	June	168	June	1		
Jul.	275	Jul.	651	Jul.	349	Jul.	39	Jul.	0	Jul.	0	Jul.	539	July	0	July	28	July	0		
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0	Aug.	1	Aug.	1	Aug.	0	Aug.	34	Aug.	0		
Sep.	767	Sep.	618	Sep.	124	Sep.	6	Sep.	0	Sep.	0	Sep.	0	Sep.	0	Sept.	23	Sep.	0		
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0	Oct.	0	Oct.	0	Oct.	0	Oct.	19	Oct.	1		
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0	Nov.	0	Nov.	0	Nov.	0	Nov.	12	Nov.	0		
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0	Dec.	0	Dec.	0	Dec.	0	Dec.	4	Dec.	0		
Total	4327	Total	6715	Total	2294	Total	372	Total	15	Total	4	Total	540	Total	0	Total	873	Total	11		

QUARANTINE DEPARTMENT

Report on Inspections and Interceptions, All Ports and Stations, for the Quarter Ending March 31st, 1924

SHIPS INSPECTED:		
From foreign ports	580	
From U. S. ports other than Florida	456	
From Florida ports	243	
Total		1,279
NUMBER OF PARCELS INSPECTED:		
Arriving by water:		
Passed	155,609	
Treated and passed	21,872	
Returned to shipper	349	
Contraband destroyed	1,579	
Total		179,409
Arriving by land, express, freight, wagon, etc.:		
Passed	3,181½	
Treated and passed	1,608	
Returned to shipper	15	
Contraband destroyed	51½	
Total		4,856
Arriving by mail:		
Passed	933	
Treated and passed	16	
Returned to shipper	51	
Contraband destroyed	2	
Total		1,002

GRAND TOTAL OF PARCELS INSPECTED: 185,267

Number of parcels on hand pending determination as to final disposition 1,003

PRINCIPAL PESTS INTERCEPTED DURING THE QUARTER ENDING MARCH 31ST, 1924

Insect or Disease	From	No. Shipments Intercepted.
Black Fly *(Aleurocanthus woglumi* Ashby)	Cuba	4
Black Fly *(Aleurocanthus woglumi* Ashby)	Bahama Islands	1
Coccus viridis (Green)	Cuba	3
Pseudaonidia paeoniae (Ckll.)	South Carolina	1

BEE DISEASE ERADICATION

Quarterly Report for Period Ending March 31, 1924

Number of apiaries inspected	116
Number of apiaries infected with American Foul Brood	1
Number of colonies inspected	2,838
Number of colonies infected with American Foul Brood	1

THE QUARTERLY BULLETIN

State Plant Board of Florida

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RIPE-ROTS OF GRAPES AND THE COPPER ACETATES AS NON-STAINING SPRAYS FOR LATE APPLICATIONS TO CONTROL THEM

BY ARTHUR S. RHOADS,*

In a number of states, but chiefly the more southern ones, grapes frequently are attacked during the ripening period by one or more "ripe-rot" fungi. These fungi ordinarily begin their attack when the grapes begin to ripen. Not only do they attack the grapes while ripening on the vines but they may continue their development saprophytically after the grapes have been harvested and packed for shipping. The rots being reproduced within a few days in sound berries coming into contact with spores from the diseased ones, or the fungus may grow through the branches of a cluster from a single infected berry and cause the decay of other berries. As a rule these "ripe-rot" fungi cause comparatively little damage during dry seasons, but if humid or rainy weather prevails during the ripening period, as is the case in Florida, considerable damage to the crop may ensue. Only a few days of favorable weather are required for ripe-rots to develop and spread rapidly throughout the vineyard.

Three fungi are commonly responsible for the decay of ripening grapes. These are the so-called bitter-rot *(Melanconium fuligineum)*, the white rot *(Coniothyrium diplodiella)*, and anthracnose caused by the same fungus *(Glomerella cingulata)* that produces the bitter-rot of the apple and the ripe-rot of a number of fruits. The decay of ripening grapes may also be caused by still other fungi but the three cited here are the most widespread and destructive.

Of these three diseases bitter-rot and white-rot are the most important because they often attack the stem of the cluster, its branches, or even the stalks of the berries before the berries themselves are attacked. In such case the stem or its parts become dry and brittle, as a result of which the berries quickly wither and dry up. Berries attacked directly by any one of these

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three fungi develop discolored spots which quickly involve the whole berry. Later, minute pustules dot the surface of the berry more or less thickly and, if the atmosphere be not too dry, the characteristic whitish, flesh-colored or sooty-black spore masses are extruded from the pustules. With the progress of the decay the berries become more or less shrunken and finally dry up. As a rule, however, infected berries have a tendency to shell or fall off at the slightest jar, even early in the course of the decay while the berries are still plump and juicy. Such dislodged berries may appear perfectly normal to the casual observer but a careful examination will reveal the presence of numerous minute pustules.

The various "ripe-rot" fungi are a potential menace to the grape crop in that they attack the fruit at a time when spraying is no longer considered necessary for the control of black-rot, anthracnose and other diseases. An application of Bordeaux mixture is not even desirable because of the chalky blotches of spray residue left on the fruit at harvest time. Control measures for the prevention of these diseases are difficult on account of the mature condition of the fruit at the time of infection and the rapidity with which the diseases may develop. An application of Bordeaux mixture made close to the harvest season mars the appearance of the fruit and renders it unsalable. The prevention of these diseases therefore requires the substitution for the universally used Bordeaux mixture of a fungicide that will leave only a very inconspicuous or practically colorless residue on the fruit.

When a fungicide forming very inconspicuous spots on the foliage or fruit is desired some one of the cuprammonium sprays or else Burgundy mixture generally is recommended. These fungicides, however, are open to serious objection because of their tendency to cause burning. Copper-caustic soda, in which the acidity of the copper sulphate is neutralized with caustic soda, also has been recommended where a practically colorless deposit is required. This mixture, however, has had but little trial. While neutral mixtures appear to be perfectly safe, strongly alkaline mixtures are liable to cause serious burning on account of the free caustic soda present.

The copper acetates, on the other hand, form even less conspicuous deposits than the cuprammonium sprays and, for the equivalent amount of copper, are many times less injurious to the plant sprayed. They compare favorably with Bordeaux

mixture as regards effectiveness. They present in addition the important practical advantages of not burning the foliage, freedom from nozzle trouble, and are very convenient as regards the making up of spray mixtures.

While the copper acetates have been widely used for many years in France, where they have been held in high esteem as fungicides, they have been employed but little in the United States. In this country one rarely finds formulae for their use and, save for the work of Galloway, Shear and Butler, they are practically unknown. On the other hand, in all French textbooks from Viala's "Les maladies de la vigne" onwards, verdigris or basic copper acetate and, more recently, the neutral copper acetate are considered to be equal, if not superior, to the other copper sprays.

The copper acetates may be considered under two headings:

1.—Basic acetate of copper, or verdigris ("verdet gris" of the French), is of somewhat variable composition but consists mainly of bibasic copper acetate and contains from 33 to 35 per cent of copper. The majority of the verdigris used in this country is imported from France. The imported product usually occurs in small amorphous lumps of the blue-gray color or else in granulated form. Verdigris is the older of the copper acetates and at present the cheapest and most easily obtainable in this country. It has been quoted by one wholesale chemical company as low as 22 cents per pound in 220 pound barrels and 25 cents per pound in small lots, both prices being f. o. b. shipping point.

In water the basic copper acetate or verdigris does not give a true solution as does the neutral copper acetate, but rather a semicolloidal one. Upon stirring into a considerable amount of water it appears to dissolve completely but really splits up into a soluble part (neutral copper acetate), which colors the solution blue, and an insoluble part, which forms an inconspicuous, olive-green, flocculent precipitate. This precipitate settles slowly but the slightest agitation again places it in suspension. It is this extreme lightness of the precipitate which insures the great freedom from nozzle clogging characteristic of verdigris mixtures. With the imported prime French verdigris tested, however, no preliminary soaking was found necessary. Stirring it into the required amount of water gave in a few minutes the blue solution with the precipitate in suspension in the ultimate form for spraying.

2.—The neutral or normal acetate of copper ("verdet neutre" of the French), a salt of more recent introduction than verdigris and containing 31 percent of copper is a crystalline salt resembling copper sulphate but with a greenish-blue color very similar to fresh chrome alum. It dissolves readily and completely in cold water, forming a clear, greenish-blue solution with a faint acetic odor. Being applied in the form of a clear solution, it insures absolute freedom from clogging of nozzles. While the neutral copper acetate is harmless to the foliage at the strength ordinarily used, it is probably more conducive to burning than verdigris, at least in wet weather. This is because drying of the solution is retarded and the salt, being soluble, acts corrosively. The extent to which decomposition occurs depends on the temperature prevailing at the time the fungicide is applied. Decomposition takes place less rapidly and less completely in cold than in warm weather. The basic copper acetate decomposes even more rapidly and completely upon drying than does the neutral acetate.

The adhesiveness of the copper acetates depends upon the degree to which they decompose on drying and upon the length of time that elapses between the time of application and the time of the first washing rain. As has been shown by Butler, the basic acetate is more adhesive than the neutral acetate and decomposes more rapidly upon exposure to the air than the latter. The adhesiveness and spread of the copper acetate spray solutions can be increased greatly by the use of gelatine.

Applications of verdigris solution at strengths varying from 1 to 4 pounds to 50 gallons of water, made in a vineyard during the summer of 1923, gave every indication of constituting an excellent fungicide. Owing to the extreme dryness of the latter part of the summer and the comparative freedom from attacks by "ripe-rot" fungi it is still somewhat uncertain as to just what strength the copper acetates should be used to secure the maximum efficiency in the control of these rots without using an excessive amount of material.

Both the copper acetates contain a higher percentage of metallic copper than bluestone or crystallized copper sulphate, the copper content of which is 25 per cent. The neutral acetate contains 31 percent, while the basic acetate or verdigris contains from 33 to 35 per cent of the metal. Since copper is the active fungicidal agent, it follows that the copper acetates

can afford equal protection in weaker mixtures than are needed if copper sulphate be used.

In France a 1 percent solution of either of the copper acetates is considered to be as effective as a 2 percent Bordeaux or Burgundy mixture. This would mean 4 pounds of the copper acetate to 50 gallons of the United States measure. The 2 per cent Bordeaux mixture standard in France is equivalent to an 8-4-50 formula, United States measure. This would be just twice as strong in copper sulphate as the 4-4-50 formula in standard use in this country. From this it may be deduced that 2 pounds of copper acetate to 50 gallons of water would be equivalent in fungicidal value to our 4-4-50 Bordeaux mixture. Shear, however, who has made numerous grape spraying experiments in several states, recommends the use of 1 pound of copper acetate to 50 gallons of water. More recently, Butler recommends two strengths of the copper acetates, namely, 1 and 4 pounds to 50 gallons, the weaker for use in lieu of a cuprammonium spray and the stronger when it is desirable to use a colorless spray in lieu of Bordeaux mixture and of the same fungicidal value. The writer is inclined to favor as a late spray for grapes the use of the copper acetates at the rate of 2 pounds to 50 gallons. While they may be used safely at twice this strength, the increase in the strength is not believed to be necessary for effective control of grape rots.

Stock solutions of the copper acetates containing 1 pound per gallon should be made up according to the quantity of spray solution desired. If the basic acetate or verdigris be used the spray solution can be prepared in a few minutes by stirring the required amount of verdigris into the water. Solutions of the neutral acetate require somewhat longer to make as this salt occurs in coarse crystalline form like copper sulphate. It may be stirred in the water until dissolved, or the crystals may be suspended in a burlap sack near the surface of the water. No attempt should be made to hasten the dissolution by means of hot water. The following amounts will be required for 50 gallons of spray mixture:

Water	48 gallons
Stock solution of basic acetate of copper (verdigris)	2 gallons

When gelatine is added to increase the adhesiveness, which is always required when the neutral acetate is used and which

is decidedly advantageous even when the basic acetate or verdigris is used, the formula becomes:

Water		47 gallons
Stock solution of	basic copper acetate (verdigris) or neutral acetate of copper	2 gallons
Stock solution of gelatine		1 gallon

The stock solution of gelatine is made by dissolving 4 ounces of an inexpensive grade of gelatine in a gallon of boiling water. After cooling, this is added to the copper acetate solution previously diluted to spraying strength, stirring thoroughly.

An off-colored grade of gelatine known as "last run" gelatine can be purchased for as low as 35 cents per pound. Solutions of gelatine should not be made up very far in advance of using since they are very subject to putrefaction. In case they are not used shortly after their preparation it is well to stir in a small quantity of the copper acetate stock solution, half a pint to each gallon being a reasonable quantity.

Despite the greatly increased cost of the copper acetates as compared to copper sulphate the basic copper acetate or verdigris is by no means prohibitive in price when its value for a final application on the ripening grapes is considered.

GRAPE DISEASES, WITH SPECIAL REFERENCE TO BLACK-ROT AND ANTHRACNOSE

By Arthur S. Rhoads,*

With the gradual extension and development of the grape-growing industry there has also been an increase in the distribution and destructiveness of the fungous diseases attacking the grape, most of which are indigenous to this country, coming originally from the native wild grapes, although a few have been introduced from Europe. Man's activity in grape culture and in the breeding of new varieties has disturbed the equilibrium which has been established between the vine and the parasites in their wild state and has facilitated the reproduction of these diseases on the cultivated vines. In the selection and breeding of the grape attention has been devoted chiefly to the improvement of the fruit, which has resulted frequently in a decrease of the natural powers of resistance to disease

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originally possessed by the wild vines. As a result there is a great range of susceptibility among our cultivated grapes to the various diseases attacking them, although, while different varieties show varying degrees of susceptibility to the several diseases, none of the commonly cultivated varieties are generally resistant to the more important diseases. This difference in susceptibility to diseases is shown at the one extreme by the European, or vinifera, grape, which is especially susceptible, and at the other extreme by the muscadine grape, which is notably resistant. With us, only varieties having an appreciable percentage of native blood exhibit much resistance to diseases. Unfortunately, however, with the increase of native blood there is also a marked decrease in quality. The more pressing problem confronting the Florida viticulturist at present is that of breeding in this state varieties that are more resistant to disease and yet which rank high in quality. For the present the best thing the grape grower in Florida can do is to be especially careful in the choice of his varieties, the vineyard site, the type of pruning, and in the control of the various diseases and insects by timely spray applications.

The severity of the action of fungous parasites attacking the grape depends largely upon weather conditions and in this connection it may be said that those that usually prevail in May and June, during the time the fruit ripens in Florida, are very favorable for the development and spread of grape diseases. The conditions most favorable for the development of the majority of the fungous diseases are low-lying, damp situations and a high degree of atmospheric moisture and heat. Rains of short duration, followed by sunshine and wind, which quickly dry off the vines, are not especially favorable to the spread of the fungi. Protracted periods of humid, rainy weather, however, furnish ideal conditions for their rapid development. On the other hand, long dry periods greatly check their development. Vines which are kept thrifty and vigorous by proper care and cultivation are not so likely to suffer as severely from most diseases as those which have been neglected. The selection of a well-drained vineyard site and the adoption of good cultural practices go a long way in the prevention and control of fungous diseases. For additional protection the grower must rely upon intelligent, efficient and timely spraying.

Efficiency in the control of the fungous diseases of grapes is becoming more and more dependent upon a fundamental knowledge of the nature and habits of the causal parasites,

how and when they start upon the vines, how they propagate themselves, what changes they pass through in their development, how they maintain their existence through the winter season, and finally, what circumstances are favorable or unfavorable to their growth and spread. The grower should be able to recognize the trouble affecting his vines so that he may know what control measures to adopt and when to adopt them, instead of working blindly and spraying just on the general belief that it ought to do some good. Spraying, which centers around the control of black-rot, should be both timely and thorough. In general it may be said that the frequency of the applications depends largely upon the weather conditions, more applications being needed in rainy seasons than in dry ones.

Two of the most serious fungous diseases of the grape, black-rot and anthracnose, are known to occur on the Carman and other grapes in Florida and the present paper will be limited to a discussion of these diseases, which, in other localities, are frequently very serious, entire crops having been destroyed by them where proper practice of control methods has not been followed. Experience alone can determine just how serious these or other diseases to which grapes are subject will become in Florida. All grape growers should be on the lookout for the appearance of these or other diseases in their vineyards and should take immediate steps to prevent their development and spread by thorough spraying with the fungicides which have been found effective in controlling these diseases in other localities and on other varieties.

Black Rot

Importance and Occurrence.—In regions east of the Rocky Mountains black-rot is the most generally distributed and destructive disease of the grape, occurring on practically all wild and cultivated vines. What apparently was black-rot was known in this country as early as 1804 but the first important records of this disease come from Missouri in 1861. At that time there was a rise in the grape industry near St. Louis, which, especially from 1860 to 1864, was accompanied by epidemics of black-rot. Since then heavy losses due to black-rot have been experienced in a number of states and in many sections the disease proved so destructive that grape growing has been abandoned. The existence of black-rot in the interior of virgin forests upon most of the wild species of grapevines of the United States, from the Rocky Mountains to the Atlantic

Ocean and from Canada to the Gulf of Mexico, proves beyond question that the disease is of American origin.

The loss from black-rot varies greatly from year to year, according to the weather. This disease is much worse in warm, humid or rainy weather than in dry times, and a few days of favorable weather may so stimulate the growth of the causal fungus as to develop an epidemic, which may in turn be checked by a dry spell. Often the disease appears in distinct waves during the summer, each wave corresponding to a climatic period favorable to infection and usually lagging behind such a favorable period from 8 to 14 days, the time necessary after infection for the disease to become conspicuous enough to attract the attention of the vineyardist. During wet seasons, where the disease is severe and spraying is not practiced, losses as high as 75 to 80 per cent have been reported in some localities, and in some vineyards there has been a total loss due to the destructive action of black-rot. In such cases the cost of cleaning out the rotten berries proves greater than the value of the dilapidated bunches remaining.

It seems to be the general experience that practically all the more commonly cultivated varieties of bunch grapes are more or less susceptible. The muscadine group is much more resistant to attack than any other. There is a great difference in the resistance of varieties according to their environmental conditions. For commerical purposes grape growing—other than muscadine—would be impossible in most localities on account of the great losses entailed, if the disease were not controllable by spraying and cultural practice.

Symptoms.—All the green parts of the vine are subject to attack by black-rot, but the damage to the fruit is by far the most important. Where rainy weather prevails during the blooming period and the fungus is abundant it may even attack the blossom clusters, causing them to rot, blacken, and to dry up and fall off. The young berries may be attacked but as a rule they are not attacked until about half grown.

On the leaves black-rot appears in late spring in the form of sharply defined, reddish-brown, more or less circular spots. These may be few or many, according to the severity of the infection. As the spots increase in size the central areas become ashen-gray but the margins remain brown. During the course of the summer, when the spot has attained full size, a series of minute, black fruiting bodies, most abundant on the

marginal portion of the spot, break through the cuticle on the upper surface of the leaf.

On the stems, tendrils, fruit-stalks, leaf-stalks, and leaf-veins the character of the black-rot lesions is somewhat different from that on the leaves. They first appear as small dark depressions which soon become black. The lesions vary in form, appearing as small circular to elliptical or much elongated spots, which may be as much as ½ to ¾ of an inch long. Numerous minute, black pustules or fruiting-bodies eventually appear on these lesions. On the canes the lesions rarely extend more than a quarter of the distance around and never extend so deep as to cut off the sap supply. The latter, however, occasionally happens on the leaf-stalks, quite commonly on the tendrils and berry stalks, but rarely on the stems of the clusters.

On the berries, which ordinarily are not attacked until after the fruit is half grown, black-rot appears as small circular, purplish or livid brown, soft spots which quickly become flattened or sunken. When the rotted spot is about ⅜ of an inch or more in diameter numerous minute brown specks appear at the center. These are the fruiting-bodies of the black-rot organism, which very shortly become so numerous as to give the spot a blackish aspect. As a rule the rot quickly involves the whole berry. At about the same time that the blackening appears the berry begins to lose its spherical contour and to shrivel perceptibly. Many of these rotten berries drop, but most of them cling to the vine and become dry, hard, wrinkled mummies with pustules or fruiting-bodies dotting the entire surface. Occasional berries on a cluster, parts of a cluster, or even the whole cluster may be attacked by the black-rot and the fruit reduced to mummies. At this stage the disease is unmistakable. When the berries have become dry, hard mummies they cling to the bunches with great tenacity and clusters thus affected commonly remain hanging on the vines throughout the winter and late into the following summer unless dislodged in pruning.

Cause.—Black-rot is caused by a fungus known as *Guignardia bidwelli* (Ell.) V. & R. The trouble begins in the spring when the spores are liberated from their hibernating quarters on the old canes, tendrils or the mummied fruit, including both that still hanging on the vines and that which may be lying on the ground. With the absorption of water the winter spores are discharged into the air with considerable force and may be distributed about the vineyard by air currents. Also in the spring the so-called summer spores, which have hibernated in the pustules on the old canes, tendrils or hanging clusters of

mummied fruit, ooze out of these pustules in long, curled threads. These spores may be washed or splattered by rain to the adjacent susceptible parts. Both the summer spores and the winter spores therefore may start the disease in the spring. Under favorable conditions these spores germinate and the resulting germ tubes penetrate and infect the vines. The first infections of each season occur on the leaves, leaf-stalks, stems, and tendrils. Later in the season the berries become infected. Apparently only the young and actively growing leaves and shoots of the vine are susceptible to infection. The berries are subject to infection at any stage of development up until they are nearly ripe. For some time the fungus is developing its filaments within the diseased fruit and it may be several days before there is any visible evidence of the disease. The length of this period varies with the weather conditions. It is materially reduced in hot weather and considerably lengthened in cool weather. In tender, juicy fruits this period is shorter than on the stems or leaves. After infection it is usually from 8 to 14 days before the disease makes its appearance on the fruit, and from 10 to 21 days before it appears on the leaves.

The cells of the diseased berry at the point of infection are killed, after which they collapse and the surface becomes sunken. Similar action takes place in the leaves, canes and other parts attacked. On the canes and tendrils the diseased spots frequently cause lentil-shaped cracks in the bark. This is caused by the diseased bark not keeping pace in growth with that of the other parts. Soon there follows the development of numerous blackish pustules, which are the fruiting-bodies. These develop just beneath the epidermis and ultimately produce a crop of spores. The latter are imbedded in a mass of gelatinous matter and, when moistened, a marked swelling of the mass occurs and the spores are forced out in a thread-like coil through the ruptured place in the epidermis. These spores may be washed or splattered by rain to other susceptible parts, where new infections may arise. This process of spore formation may continue throughout the summer.

With the advent of autumn the fungus ceases growing. As stated before, some of the pustules live through the winter and are ready to produce spores in the spring. During the winter and spring another spore form, or winter spore, may develop in many of the pustules of the mummied fruit remaining in the vineyard, either upon the vines or lying on the ground. These spores begin to be discharged in the spring and, while

most of them probably are discharged by June, the discharge continues to a lesser extent throughout the summer. With two kinds of spores present in an infected vineyard it is not difficult to understand how the fruit of unsprayed, susceptible varieties may be destroyed quickly during a period favorable to the development of the fungus.

Control Measures.—Black-rot can be effectually controlled by a series of timely and thorough sprayings with Bordeaux mixture. The control of black-rot and many other grape diseases as well, however, can be greatly facilitated by vineyard sanitation. Anything that will help to eradicate the fungus in its winter quarters will be of importance in the control of this disease. Since the infection of the vineyard in the spring comes from the infected canes, tendrils, clingers, and old mummied fruit, it is highly desirable to get rid of these sources of infection in so far as possible. The most vulnerable point of attack is against the mummied fruit. After the work in the packing shed is over the litter of rotten fruit that has been culled out or may have accumulated on the ground about the packing shed should be cleaned up and burned or buried. When the vineyard is pruned those canes bearing numerous black-rot lesions should be cut out. At the same time any clusters of mummied fruit remaining on the vines should be collected and burned. All trimmings from the vines should likewise be collected and burned. Although desirable, it is not believed profitable to collect or burn off the old clinging tendrils from the wires.

In the spring, before the new growth appears, the vineyard should be thoroughly plowed, care being taken not to injure the roots of the vines. A horse-hoe may be used to work up close to the vines. This tillage of the vineyard, in addition to being good viticultural practice, serves to bury the fallen fruit so that the spores disseminated later can not infect the vines.

It is highly desirable that good soil drainage be maintained in order to reduce the amount of surface moisture and to allow of a more rapid drying after rain. Air drainage is also of much importance, especially in vineyards located in valleys or on level land, since a good circulation of air aids in the rapid evaporation of surface moisture from the vines after rain, dew and fog, and thus retards the germination of spores and consequent infections. Having the trellis wires too low or allowing them to sag greatly retards the circulation of air through the vineyard. For the same reason the shoots should not be

allowed to hang down to the ground nor should basal sprouts be allowed to spread out over the ground, for they constitute prime centers of infection. Weeds and grass are not only a detriment to good air drainage but, in addition, help to increase the humidity of the air about the vine and thus favor the development of the fungus.

The important thing in spraying for the control of black-rot is to prevent the spores from the old mummied fruit, diseased canes, and tendrils from infecting the new growth. This can be done effectively by a series of timely and thorough sprayings with Bordeaux mixture, accompanied by an intelligent system of vineyard sanitation.

Spray thoroughly with Bordeaux mixture (4-3-50), first when the shoots are from 8 to 12 inches long; second, just after the blossoms are swelling and before they begin to open; third, after the blossoms have fallen and the fruit set. The addition of one pound of a calcium caseinate spreader to each 50 gallons of the Bordeaux mixture will be found of value in increasing the spreading and adhesiveness of the spray mixture. The remaining applications should be made at intervals of ten days to two weeks, depending upon the weather and the severity of the disease. If the weather is dry, applications need not be so frequent, but, if the weather is wet, especially after the fruit has set, the applications should be made at least every ten days until within a month of harvest time. After this date, it is preferable to use some one of the sprays leaving a practically colorless deposit, such as the copper acetates. If black-rot is present in the vineyard at least five spray applications will be necessary to control it, and some seasons six or seven are necessary. To secure satisfactory results the spraying must be timely and thorough so as to cover as nearly as possible the entire surface of the foliage, shoots and fruit with a fine spray.

It has been shown by a number of investigators that the presence of moisture is necessary for the discharge of black-rot spores. It will thus be seen that in order to successfully protect the vines and fruit from infection it will be necessary to have them covered with the fungicide before the spores are shed, instead of afterward, so that their germination and the resulting infection can be prevented. Careful study of the weather forecasts will render this possible. It has been shown that Bordeaux mixture properly made and applied will be only slightly washed off even after a continued rain of 24 hours.

Growers can not expect to free a badly infected vineyard

from black-rot in one season, nor even two. By a systematic campaign of vineyard sanitation and by thorough spraying, the developing shoots, tendrils, leaves, and fruit may be kept free from the disease so that within a few favorable years the disease might easily be eradicated. After the disease has once been brought under control the number of spray applications required will be lessened in ordinary seasons.

Covering the bunches with paper bags of a good quality soon after the blossoms fall and the fruit has set is usually an effective means of preventing black-rot and other fungous and insect attacks; also of protection from injury by hail and attacks by birds. This is too laborious and expensive, however, except where only a small number of vines are grown or where special market prices make it advisable. Where but few grapes are grown bagging is more satisfactory than spraying in so far as protecting the fruit from rot and injury is concerned. Spraying, however, keeps the foliage in fine condition and thus increases the vigor of the vines.

ANTHRACNOSE

Importance and Occurrence.—Anthracnose or bird's-eye rot of grapes is a disease now well distributed throughout Europe and a large part of the United States. It was first discovered in this country in central Illinois in 1881 and later was found in many other parts of that state. By 1885 the disease had been noted generally over the eastern and middle western states. This disease originated in Europe, where it has occurred to a serious extent for many years. The fungus causing this disease doubtlessly was imported from Europe at some time prior to 1881.

Anthracnose ranks fourth in importance among the fungous diseases of the grape east of the Rocky Mountains, black-rot, downy mildew, and powdery mildew being more troublesome in the order listed. The disease is rather erratic in its behavior, sometimes becoming very serious in one locality or on a particular variety, but not of general occurrence over widespread areas. It is, however, a disease which may cause great injury when it becomes epidemic.

Symptoms.—All the green parts of the vine are subject to attacks of anthracnose throughout the growing season. The disease is most common, however, on the shoots and berries. In serious outbreaks the fruit may be almost wholly destroyed and the vines seriously damaged.

On the leaves it first appears as minute, irregular, dark-

brown, slightly sunken spots having a darker margin. These spots usually become lighter colored when old and frequently crack or fall out, leaving irregular holes in the leaves.

On the shoots there first appear minute brown spots, a little depressed in the middle, with a slightly raised dark-colored rim or border. These spots enlarge, becoming elongated in the direction of the main axis of the shoot. In later stages the center of the spot becomes more depressed and, with the destruction of the bark over these spots, the color becomes grayish. In severe cases the underlying wood appears as if burned or corroded, sometimes so deeply as to reach the pith, in which case the shoot is rendered weak and brittle. Not infrequently these spots or lesions tend to run together and form irregular patches. In rare cases the disease upon the shoots may be so severe as to cause the destruction of the young leaves even when the latter are not directly attacked.

On the fruit the disease is most characteristic and conspicuous and produces the well-known bird's-eye spots. The spots first appear as small dark-brown areas; later the color becomes grayish in the center wherever the cuticle is ruptured, but the border remains dark. These spots enlarge, retaining a more or less regular, rounded outline. Later the grayish centers of the spots may become somewhat sunken. As the spots enlarge they retain a more or less regular outline and between the light-colored central portion and the outer brown portion there often appears a well-defined band of bright red. The appearance thus resulting has given rise to the name "bird's eye" rot.

Frequently two or more spots unite and cover a considerable part of the berry. Berries attacked on one side when not more than half grown often become irregular in shape due to the diseased spot making no further development. With the continuation of growth by the rest of the berry the diseased side cracks open, exposing the seeds, which are gradually forced out by the unequal growth. The bursting of the berries and the exposure of the seeds, however, may be produced by other causes such as powdery mildew, hail and certain insect injuries. The affected tissues do not become softened, but the berry finally withers and dries up and becomes hard and more or less wrinkled. Often apparently nothing is left but the skin and the seeds. There is no browning of the tissues of the berry as in black-rot, nor does the skin shrivel to the extent of leaving prominent and very irregular ridges as in that disease, but the circular spots first formed are easily seen and the colorings characteristic of these bird's-eye spots are retained.

Cause.—Anthracnose is caused by a fungus known as *Spaceloma ampelinum* De By. The pustules or fruiting-bodies of the fungus appear most commonly on the diseased berries and the canker-like spots on the canes. These structures burst through the skin of the berries and canes and produce spores in great abundance. These spores ooze out in a gelatinous mass held together by their sticky coatings. This sticky substance dissolves in water, and rain or dew may easily disseminate the spores repeatedly until the close of the growing season. Spores coming into contact with the green parts of the vine germinate and in about 8 days the characteristic anthracnose spots begin to appear. With the advent of the dormant season the fungus eventually ceases activity, although in rare cases another spore form, or winter spore, is developed. The fine thread-like filaments which constitute the vegetative part of the parasite live during the winter in the tissues of the canes and mummied fruits and in the spring the spores produced in these centers of disease bring about the first infections.

The vineyard should be very carefully watched for the occurrence of anthracnose, for, when the disease once becomes established under favorable conditions, control is difficult.

Control Measures.—The following program for the control of anthracnose is based upon the results of a vast amount of research work and practical experience and should be adhered to rigidly where the disease is present.

(1). Cut out and burn all diseased canes showing cankers or anthracnose spots; also collect and burn all mummied fruit clusters. This may be done in the winter in connection with the regular pruning.

(2). Spray the vines thoroughly with lime-sulphur (1 gallon of commercial lime-sulphur to 9 gallons of water) while dormant, preferably just before growth starts in the spring. This dormant application is a general sanitary precaution and also destroys scale. Lime-sulphur solution has been found just as effective as the mixture of iron sulphate and sulphuric acid or the dilute solution of sulphuric acid formerly used as dormant fungicides, both of which were objectionable, not only because they are unpleasant and dangerous to handle, but because they are corrosive to spray machinery.

(3). Plow the vineyard in the spring. This is commendable both as good viticultural practice and in order to bury all fallen mummied fruit.

(4). During the growing season spray the vines with Bordeaux mixture the same as for black-rot.

THE QUARTERLY BULLETIN
State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*........................*Editor*

ASSOCIATE EDITORS

E. W. BERGER........................*Entomologist*
F. M. O'BYRNE........................*Nursery Inspector*
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O. F. BURGER........................*Plant Pathologist*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

AN IMMEDIATE MENACE

The Japanese beetle is one of the most serious insect pests attacking plant life. Its range of host plants is great, over two hundred different plants having been found infested in New Jersey. It feeds on foliage and fruits as an adult and on the roots of grasses as a grub. Shade and ornamental trees are attacked, as well as fruit trees. It is spreading and may reach Florida soon, despite our efforts to keep it out. Growers, be on guard!

For some years past the Plant Commissioner and his staff have from time to time called attention through talks and publications to the fact that the Japanese Beetle *(Popillia japonica* Newm.) constituted a serious menace to the horticultural interests of this country. This pest was introduced into the United States, it is believed, through the medium of a shipment of iris bulbs from Japan consigned to a large nursery concern operating at Riverton, New Jersey, but having offices in Philadelphia. It became established at Riverton. In 1916 only about a half square mile of territory was infested. The spread has been progressive, notwithstanding the repressive measures made use of. In 1922

over seven hundred square miles were involved. Last year south New Jersey, southeastern Pennsylvania and northern Delaware were invaded. Now come reports showing a great migration of the beetles across the Delaware River into Philadelphia. Indeed, if reports are to be believed, such numbers drifted or flew over from New Jersey that they actually occasioned annoyance to residents of the city.

As we go to press the writer has been informed that a live adult beetle was found on a passenger, arriving at Savannah by steamer from Philadelphia a few days since.

All of this is being recounted in order that Floridians may again be warned of this danger. Do not place orders for nursery stock to be shipped from southern New Jersey, eastern Pennsylvania or northern Delaware unless you are assured that every precaution will be taken to ship non-infested material. The safest plan is to have shipments made through the State Plant Board of Florida at Gainesville, Florida. If you receive nursery stock or plants of any kind from the areas mentioned which do not bear the inspection certificate of the State Plant Board of Florida, send at once to the State Plant Board, Gainesville, Florida. Don't take any chances of introducing the pest into Florida.

Remember! Once introduced into Florida, it means heavy losses in many directions. There is no effective means of controlling the Japanese beetle by poisoning and its natural enemies are not here.

BEE DISEASE ERADICATION

Report for Quarter Ending June 30, 1924

Number of apiaries inspected	350
Number of apiaries infected with American foul brood	3
Number of colonies inspected	6,848
Number of colonies infected with American foul brood	5

DEPARTMENT OF CITRUS CANKER ERADICATION

Report on Eradication Work in Cooperation With the Bureau of Plant Industry, U. S. Dept. of Agri., for Quarter Ending June 30, 1924

Citrus grove trees inspected	303,010
Citrus nursery trees inspected	39,235,202
Inspectors employed (entire Plant Board force)	89
Inspectors employed on canker eradication	29
New properties showing active infection	0
Total properties showing active infection	0
Grove trees found infected	0
Nursery trees found infected	0
Counties in which active infections were found	0

General Summary

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	15,151
Nursery trees found infected since May, 1914	342,260
Number properties found infected to June 30, 1924	510
Properties declared no longer "Danger centers"	501
Properties still classed as infected June 30, 1924	9

QUARANTINE DEPARTMENT

Assistant Quarantine Inspector's Quarterly Summary Quarter Ending June 30, 1924

Ships and Vessels Inspected:			
From Foreign ports	578		
From U. S. ports other than Florida	428		
From Florida ports	214		
Total		1,220	
Number of Parcels Inspected:			
Arriving by water:			
Passed	828,276		
Treated and passed	26,791		
Returned to shipper	375		
Contraband destroyed	619		
Total		856,061	
Arriving by land—Express, freight, wagon, etc.			
Passed	3,575		
Treated and passed	1,096		
Returned to shipper	31		
Contraband destroyed	123½		
Total		4,825½	
Arriving by mail:			
Passed	759		
Treated and passed	6		
Returned to shipper	51		
Contraband destroyed	3		
Total		819	
Grand Total of Parcels Inspected			861,705½
Number of parcels on hand pending determination as to final disposition		2	

Department of Citrus Canker Eradication (Report Continued)

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to June 30, 1924:

1914		1915		1916		1917		1918		1919		1920		1921		1922		1923		1924	
Jan.		Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0	Jan.	0	Jan.	0	Jan.	0	Jan.	1	Jan.	0
Feb.		Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0	Feb.	0	Feb.	0	Feb.	0	Feb.	1	Feb.	0
Mar.		Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1	Mar.	0	Mar.	0	Mar.	0	Mar.	2	Mar.	0
Apr.		Apr.	408	Apr.	49	Apr.	169	Apr.	2	Apr.	1	Apr.	0	Apr.	0	Apr.	0	Apr.	3	Apr.	0
May	108	May	1042	May	338	May	52	May	1	May	1	May	0	May	0	May	585	May	2	May	0
Jun.	160	Jun.	772	Jun.	450	Jun.	45	Jun.	10	June	0	June	0	June	0	June	168	June	1	June	0
Jul.	275	Jul.	651	Jul.	349	Jul.	39	Jul.	0	Jul.	0	Jul.	539	July	0	July	28	July	0		
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30	Aug.	0	Aug.	1	Aug.	1	Aug.	0	Aug.	34	Aug.	0		
Sep.	767	Sep.	618	Sep.	124	Sep.	6	Sep.	0	Sep.	0	Sep.	0	Sep.	0	Sept.	23	Sep.	0		
Oct.	565	Oct.	214	Oct.	451	Oct.	2	Oct.	0	Oct.	0	Oct.	0	Oct.	0	Oct.	19	Oct.	1		
Nov.	773	Nov.	494	Nov.	131	Nov.	1	Nov.	0	Nov.	0	Nov.	0	Nov.	0	Nov.	12	Nov.	0		
Dec.	366	Dec.	256	Dec.	27	Dec.	1	Dec.	0	Dec.	0	Dec.	0	Dec.	0	Dec.	4	Dec.	0		
Total	4327	Total	6715	Total	2294	Total	372	Total	15	Total	4	Total	540	Total	0	Total	873	Total	11		

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July 1, 1924

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